DOCUMENT RESUME

ED 065 374 SO 001 861

TITLE	A Multi-Disciplinary Team Approach to "The Man Made World."
INSTITUTION	Colorado State Dept. of Education, Denver.; Colorado Univ., Boulder.
SPONS AGENCY	National Science Foundation, Washington, D.C.
PUB DATE	[70]
NOTE	121p.
EDRS PRICE	MF-$0.65 HC-$6.58
DESCRIPTORS	Classroom Games; Curriculum Development; *Guidelines; Interdisciplinary Approach; Resource Guides; Science Education; Secondary Education; *Social Change; *Social Studies; *Teacher Education; Teaching Guides; Team Teaching; *Technology

ABSTRACT

These guidelines were designed to be used in a training program for thirty secondary teachers who planned to implement "The Man Made World" course in their classrooms in the fall of 1970. Emphasis is upon a multi-disciplinary team-teaching approach to help students cope in the real world. Seven chapters are included. Chapter one, the rationale of the course, focuses on the need for today's students to understand the interaction of technological development and social change. Chapter two, objectives and evaluation, suggests teaching techniques, including games, that involve students in relevant learning and in approaches to evaluating the goals and objectives which are established by individual teams. The course encourages student-teacher interaction dynamics which are discussed in chapter three. Hints to administrators and team members are given in chapter four. Chapter five, teacher preparation, emphasizes teacher training and characteristics which are helpful in teaching the course. Laboratory use and equipment is discussed in chapter six. A resource guide presented in chapter seven contains multi-media references to provide insight into the various areas that are an integral part of the course. An appendix includes multi-disciplinary learning activities. Related documents are: ED 016 634; ED 016 635; and ED 019 243. (SJM)

ED 065374 — FCCP

IN PROJECT
BOX # 1

A Multi-disciplinary, Team Approach

to

The Man Made World

SP 001 861

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A Multi-disciplinary, Team Approach

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The Man Made World

A Multi-disciplinary Team Approach
to
The Man Made World

Written by the

Engineering Concepts Curriculum Project
Multi-disciplinary Teaching Teams
from Colorado

This project was supported by the National Science Foundation under a Cooperative College School Science Program, Grant Number GW-5177, through the University of Colorado in cooperation with the Colorado State Department of Education.

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PREFACE

These guidelines have been produced to help teaching teams implement a multi-disciplinary team approach to The Man Made World[1] course which was developed by the Engineering Concepts Curriculum Project [2] (ECCP).

The writing team and initial printing of this document were supported by the National Science Foundation (NSF) through a Cooperative College School Science (CCSS) project[3] with the College of Engineering at the University of Colorado; Project Director, Dr. George Maler, Associate Dean. Some support, in the form of facilities and personnel time, was also furnished by the Jefferson County Public Schools, Lakewood, Colorado, and the Colorado Department of Education.

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[1] The Man Made World, McGraw-Hill Inc., 1968, revised 1970.

[2] Engineering Concepts Curriculum Project; Polytechnic Institute of Brooklyn, 333 Jay Street, Brooklyn, NY, 11201.

[3] N.S.F. - CCSS - Proposal, C.U. 69. 5. 289.

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This document is a consensus of the eight members of the guideline writing team which reflects their evolving philosophy of working with students and their first-hand experience in using a multi-disciplinary team teaching approach.

In writing this guideline the authors have assumed that their primary audience is a group of thirty prospective teachers who plan to implement The Man Made World on a multi-disciplinary, team basis in their respective schools in September of 1970. This group of prospective teachers is attending a training program during calendar 1970. The guide will be used extensively in this training program.

This selection of prospective multi-disciplinary team members as the primary audience for this guide allowed the writing group to cover a wider range of topics than otherwise would have been possible. The concepts dealt with in this guide require some basic understanding of The Man Made World text and course content. However, this does not mean that the guide will not be of value to other teachers and administrators. It is hoped that any school district considering implementation of The Man Made World will study this guide with the view of

possibly using a multi-disciplinary, team approach. Any of the authors of this guide will be more than happy to assist school districts in implementing such a program.

CHAPTER 1

Rationale

During the past three years many teachers of The Man Made World have emphasized the concept of the interaction of technological development and social change. Feeling that future citizens need insight into this interaction, teachers wanted to design experiences which would focus attention on the changes in social institutions and life style that result from technological developments. A second and equally important emphasis is an understanding of the demands made and the priorities established by the society as a whole, and the corresponding technological developments which are produced in response to these demands.

Most teachers of The Man Made World can see the need for courses with this emphasis. Many of them have expressed a feeling of background limitation in implementing the course with the emphasis described. For example, some teachers who are very effective at dealing with the computer as a tool by showing its usefulness in a variety of situations, find themselves at a loss in demonstrating the social implications of the computer. Similarly, other teachers, who are able to show students the universal applicability of concepts such as feedback, modeling, and a systems approach to decision making in a variety of social as well as physical situations, are equally limited in terms of dealing with the quantitative aspects of these concepts.

This feeling and insight led the teachers themselves to suggest a multi-disciplinary, team-teaching approach. The teams were made up of teachers from mathematics, science, social studies and language arts.

During the spring of 1968, teachers working with ECCP staff personnel in several feedback sessions formulated the plan for a multi-disciplinary approach. This plan resulted in five multi-disciplinary teams teaching The Man Made World in Colorado during the 1969-70 school year. Looking back on this year of experience, advantages of the multi-disciplinary team-teaching approach have been revealed and need to be recorded.

It is the consensus of this writing group that the multi-disciplinary team approach best produces a course with the desired emphasis. The teachers are able to focus the course on the interaction of technological development and social change. Both directions of this interaction can be realistically pursued and examined. Hence, students have a view of the role of technology.

The presence of a multi-disciplinary team gives each student the opportunity for multiple contact with several teachers in a single course. This diversity leads to effective communication between teachers and students. As a result each student experiences a high degree of involvement in the activities of the class.

Because they have effective communication with students, teachers are able to identify students' needs and interests. The presence of a multi-disciplinary team means that groups of students can approach a given topic in a variety of ways, each receiving guidance from a teacher whose interests parallel their own. It also means that a teacher with particular strengths can work with students whose needs are in that teacher's area of expertise. In general, this approach provides identification of the strength of each teacher and student. These strengths can be used to increase the value of the class activities.

In every case, teachers experience an expansion of their role. While all team members are knowledgeable in the fundamental concepts of the course, the real expertise of each is in the application of these concepts to his own area, be it social studies, language arts, mathematics or science. Thus the teacher is, at the same time, an expert and a fellow learner with the students.

This expanded role of the teacher also provides insight for students. They observe several teachers with differing viewpoints, each contributing effectively to all the class activities. As a result, expertise from a variety of disciplines is seen by students as an essential element in formulating valid solutions to complex modern problems. This is a realistic view of the reality of good human interaction: that is to say, people with a variety of backgrounds contributing their own unique abilities, under an agreed upon set of procedures, to achieve optimum solutions to problems.

Teachers involved in a multi-disciplinary, team approach experience increased professional growth. This growth occurs not only in terms of content material but also in terms of the ability to interact meaningfully with students and other teachers. Evaluation of ones' efforts by students and team members from other disciplines is a new experience for most teachers. This feedback helps to increase each teacher's effectiveness. It provides the teacher with new understanding of the students and new respect for fellow teachers from other disciplines.

CHAPTER 2

Objectives and Evaluation

2-1 Introduction

Those who encounter The Man Made World will find it a refreshing and unique experience for both student and teacher--and therein lies the danger. The point is, that it is not a course designed to exploit novelty, but to provide students with the opportunity to encounter the "real world" in a meaningful and sometimes novel way. The danger lies in one's tendency to perpetuate novelty rather than accomplish realistic goals and objectives.

The Man Made World seeks to maintain the content integrity of other disciplines; it seeks to synthesize and integrate curriculum; in short, it seeks to be relevant.

There are large numbers of games and activities which find relevancy in this course--and even more than those available are those which students themselves will create. Students tend to be "game" oriented and, therefore, it is important for the team to remain conscious of it's responsibility to help students identify the relevance and meaning of these activities.

Because of this tendency toward a "game" syndrome, realistic goals and objectives, clearly and concisely stated, are of the utmost importance and not to be taken lightly.

The following goals and objectives have been suggested by high school multi-disciplinary teams who have had experience with this approach. It is to be understood, however, that the list is neither exhaustive nor minimal in its scope. Teams must learn to identify

for themselves those objectives which are most pertinent to their situation, and in this regard, must remain highly sensitive to the needs of their students.

The objectives listed here do represent a concerted effort to identify measurable outcomes, which can be assessed and evaluated by both team and student. Expressions such as, "to be exposed to," "to construct," "to apply," "to collect and interpret", and "internalize" are much more difficult to translate into observable activity, although they indicate important outcomes.

It is, therefore, desirable to restrict the use of the latter terminology to general goals of the course and reserve the former for specific student objectives. Inherent in such an approach is the assumption that success in the accomplishment of specific objectives that will result in the accomplishment of course goals will depend upon the ability of student and teacher to view specific objectives in terms of the whole course.

It is impossible to over-emphasize the dynamic evolving nature of The Man Made World or its objectives. The evaluation process should result in a reassessment of objectives in light of student input and a constantly changing society. The technological responses to a dynamic society will demand new activities and continuous course adjustments.

Now a word about the evaluation section, which consists of suggested approaches to evaluating the goals and objectives which are established by individual teams.

It is generally conceded that an overemphasis upon objective forms of evaluation may detract from the accomplishment of overall course goals. A greater emphasis upon more subjective forms of evaluation is considered to be effective in producing a conscious awareness of the importance of one's growth in such areas as fluency and flexibility, integration and synthesis, and divergent thinking patterns. It is just as readily conceded that evaluation techniques designed to get at such internalized outcomes are not easily translated into quantitative grading scales. Nevertheless, such evaluation techniques are important, whether or not they can be translated into grades. Therefore, some suggested "axioms" for evaluation follow:

a) Objective techniques should be restricted to mechanical skill-oriented goals.

b) Subjective techniques should, as much as possible, incorporate student and group self-evaluation.

c) Students should be involved in developing criteria to be used for grading. (possibly as a modeling exercise)

d) Grades should result from both subjective and objective evaluation.

2-2 Student Goals and Objectives

The following goals and objectives for a multi-discipline team approach to The Man Made World are suggested by high school teams who have had experience with this approach.

In an attempt to simplify the diverse activities which may take place in such a curriculum offering, four main headings have been listed:

I. Decision Making

II. Modeling

III. Man-Machine Interaction

IV. Technology-Society Interface

I. Decision Making

A. General Goals:

To understand the systems approach to decision making in terms of the elements, techniques, and consequences of the decision.

To understand the significance of the algorithm as an optimizing technique.

To understand that optimization of solutions to complex problems, affecting society, requires a systems approach and that many different types of insight and expertise are necessary to solve such problems.

B. Specific Objectives:

The student will:

Develop techniques for collecting data for a variety of decision-making situations.

Analyze the reliability of data and recognize the necessity of analyzing the reliability of data.

Identify constraints to various decision-making problems.

Formulate criteria and assign priorities to conflicting criteria.

Be exposed to a variety of optimization techniques.

Formulate and apply algorithms to traditional and student-devised problems.

Construct various kinds of models.

Examine the value of modeling in contemporary environmental and sociological decision making, through the actual construction of such models.

Apply the model as an instrument of prediction.

II. Modeling

A. General Goals:

To construct dynamic and static models which represent real-world systems.

To apply such models to decision-making situations in order to enhance predictability and optimization of outcomes.

B. Specific Objectives:

The student constructs and applies the following kinds of models:*

1. Descriptive - written statement of the situation.

2. Mathematical - algebraic.

3. Digital computer programs.

4. Circuits on the logic circuit board.

5. Circuits on the analog computer.

6. Graphical

7. Physical

8. Esthetic: drama, art, music, poetry.

*For a given modeling task the student should be able to produce a variety of models (originality and divergence are emphasized).

The student will:

Apply one model to several conditions of the real world.

Construct feedback mechanisms to achieve goals.

State predictions based upon his model.

Differentiate between dynamic and static models and systems.

III. Man-Machine Interaction

A. General Goals:

To demonstrate that man designs devices which enable him to survive and to alter his environment.

To understand the necessity of the "machine" as an extension of man.

B. Specific Objectives:

The student will:

Identify physiological, biological and intellectual limitations of man.

Demonstrate the necessity for machines to support these limitations.

Demonstrate that the use of a machine requires input and output.

Describe ways in which man uses technology to extend his intellectual and biological abilities to provide alternative life styles, efficiency in performing tasks, more leisure and pleasure, and better ways to gather information.

Distinguish between planned and unpredicted uses of a machine.

Describe new uses for existing machines.

IV. Technology-Society Interface

A. General Goals:

The student should comprehend the requirements that society places upon technology as a result of societal needs.

The student should understand the effects of technology upon society.

B. Specific Objectives:

The student will:

Interpret his own limitations and the necessity for technological extensions of himself.

Describe societal changes which were not predicted and which occured as a result of technical developments.

Identify ways to effect change in our society.

Identify situations in which technology has affected value constructs within society.

Construct and apply a model of a technological development and analyze the change in society as a result of that development.

Identify ways in which society effects changes in technology.

2-3 Evaluation

The following is a list of suggested techniques to be used by students and teachers in evaluating the objectives and goals of The Man Made World. However, after careful scrutiny of the objectives, it should be apparent that evaluation has been dictated by the nature and design of the specific objectives being treated.

The evaluation suggestions and techniques have been divided into two categories: I) student, and II) team.

I. Student

A. Contract:

The contract method requires a predetermined set of criteria which, if satisfied, justifies a particular grade. Such a system of grading can be used on project, quarter, or semester basis, but is generally restricted to individual projects, due to the unpredictable and flexible nature of the course.

B. Self-evaluation.

Each student should be provided with the opportunity to evaluate his own progress through teacher interviews, Likert scales (example follows) and project analysis. Such opportunity can provide both student and teacher with greater insight into student progress beyond the cognitive level and make subjective grading more meaningful and palatable to the student.

C. Group:

Group activities are prevalent and indicate a need for group evaluation. It is suggested that not only does the group evaluate such things as their collective efforts to plan, organize, coordinate and integrate, but that each individual be given the opportunity to evaluate his own relationship and contribution to the goals of the group.

D. Objective Testing:

Traditional forms of testing are most appropriate for mechanical and skill-oriented activities such as: application of techniques to problem solving, math skills, hardware, flow charting, etc.

II. Team

The following is a list for teams to consider when evaluating their own performance. Techniques are left to the team. It should be noted that both peer and student input is considered vital in the process.

A. How well is time used?

B. Is team interaction, in both planning and teaching situations, effective?

C. How well does the team use student-grouping techniques?

D. How well does each team member understand his role?

E. How much differentiation in job responsibility is there, and how much should there be?

F. How effectively are outside human resources used to complement the team?

G. Does one team member dominate excessively?

H. Is the team using the physical facilities effectively?

I. How well and how many of the basic objectives and principles were covered? If some were omitted, why?

J. Were students given the opportunity to evaluate team and course?

K. How much idle time did the student experience as a direct result of ineffective team operation?

2-4 Example of Likert Scale

Objective:

To construct a dynamic model of population growth.

	Low				High
Knowledge	1	2	3	4	5
Interest	1	2	3	4	5
Relevance	1	2	3	4	5

The Likert scale is a simple, self-evaluation instrument to be used by the student in a self-analysis of the various categories of cognitive and sub-cognitive areas of comprehension.

The student should be asked to rate himself, in the categories specified, before and after completion of the topic being treated.

The categories may be altered to fit the need, but the student should have a clear understanding of the meaning of each term.

Student explanation, oral or written, of his rating might be helpful to both teacher and student.

CHAPTER 3

Student-Teacher Interaction Dynamics

3-1 Introduction

Academicians and educators have long pondered the questions of what distinguishes an educator from the merely educated. What sets a teacher apart from any other non-certificated college graduate? The answer must somehow be found in the unique interaction between an adult and 30 adolescents--some relationship whereby learning is facilitated. The multi-disciplinary Man Made World course is no exception. However, due to its uniqueness, a reassessment of this relationship relative to the long-established curricula is in order. The Man Made World teacher will spend a considerable amount of time interacting with individuals and small groups of students.

Decision making in the real world is a primary concern in the course. The concern is not merely in teaching the subject matter of decision making so much as a new and exciting way of applying it to real-world situations. In this course every student is thereby offered a unique and fresh opportunity for success.

Implementation of the elements and concepts of decision making can only be successful with a variety of applications and practices. This, in fact, is the aspect of The Man Made World multi-disciplinary approach which renders it unique. Each person interprets the real world through his own life experience. The teacher, therefore, must incorporate adequate flexibility in conducting the class to allow the students to pursue individual interests and arrive at alternative

ends in decision-making activities reflecting their own life experiences. To this end let us explore some roles of the teachers in the course.

3-2 The Teacher as an Expert

The term "expert" implies a source of final answers and correct information. In a multi-disciplinary course concerning decision making, however, an expert can only exist if he knows everything there is to know about all academic disciplines as well as human values and priorities. If the teacher has any realm of expertise in the course it must lie in his understanding of the process involved in decision making rather than in all the subject matter to which this process is applied.

Rather than viewing this as a source of frustration, however, the teacher should see a wealth of opportunities for himself and his students to achieve academic success. First, rather than being a source of final answers, the teacher must be viewed by the students as a fellow inquirer in a common endeavor to learn and reach conclusions about a variety of interesting aspects of the real world. The teacher must be comfortable in admitting ignorance of a particular real-world topic and follow with a sincere and enthusiastic desire to learn. The joy and spirit of inquiry will rapidly disseminate among the students as a result.

3-3 The Teacher as a Planner

There is no doubt that well-made plans offer a great deal of comfort and confidence in the teaching profession. Again The Man Made World multi-disciplinary course is no exception. While there

is a place for planning in this course, at times, successful implementation of the material requires a dynamic and open structure to provide latitude for student initiative and direction. Plans should provide for much flexibility.

On the one hand, the teaching of the systems approach to decision making requires of the teacher well-made plans. On the other hand, the application and practice of this system should permit the student the freedom of exploration and experimentation. After all, the teacher has only one life experience and, thereby, only one interpretation of the real world. Each and every student has yet another. Therefore, not only will the student benefit by the freedom to pursue decision making in the context of his own interests and abilities, but the teacher may glean fresh approaches to teaching The Man Made World to other students at other times.

In summary, the planning of the course requires both the participation of the teacher and of the students if the classroom is to reflect the very essence of the course, namely the making of decisions in the real world. Leave plenty of room for student initiative in planning.

3-4 The Teacher as Motivator

Motivation has long stood as one of the challenges to teachers and in the multi-disciplinary approach the challenge is indeed unique. Fortunately, motivation is inherent in the wide scope of the course if one assumes that every student is excited and interested about some phase of the real world around him. The teacher may offer

direction in this regard; but, more often, teachers have found that greater motivation may be achieved when the teacher assumes a more passive role, allowing students to relate the concepts of decision making to their own world. A perceptive teacher can amplify this inherent motivation through an enthusiastic receptiveness to the students' interests. Respect for student opinions and interests is essential when initiative is shown.

Motivation is further built into the many learning activities which have been written, not to mention those which the teacher and his students will develop during the course. The danger of the "game" syndrome identified in Chapter 2 of this manual deserves reiteration at this point. There are many games in the course, which may become irrelevant if their purpose becomes clouded in the excitement of participation. If, however, the relevance is not lost and is appropriately identified, the excitement takes on profound and meaningful dimensions.

While motivation is very important, let the teacher avoid defeating his purpose by imposing that which is only of personal interest. Rather, be alert to the inherent motivation which already exists in the students and let The Man Made World become a vehicle for each student to pursue his own personal interests in a novel and relevant manner.

3-5 The Teacher as Evaluator

Evaluation and grading has evolved to a number of standard formats in traditional curricula. The uniqueness of the multi-disciplinary approach, however, requires a new orientation to evaluation. The teacher may find himself evaluating the application

of systematic decision making to a context in which he has minimal training and knowledge. Furthermore, how does a teacher place a letter grade on human values and personal interests of the students?

First and foremost is open-mindedness and respect for the student. This is a rather lofty statement, but it must not be taken lightly if meaningful evaluation is to occur. Evaluation in this multi-disciplinary course is a constant and subtle undertaking, much more so than in the traditional curricula. It is manifest each time the teacher or students react to someone's efforts. For example, evaluation is implicit in a compliment or smile. It occurs when the teacher calls the attention of the class to one of the student's endeavors as an area of particular interest or as a job well-done. Subjective as it may be, that alone does not warrant neglect of this important aspect of evaluation; rather it should be apparent in assigning a letter grade to the student for the course.

Consistent with the unique orientation of the teacher as a fellow inquirer is the orientation as a fellow evaluator. Because the student may be dealing with topics which are relatively unfamiliar to the teacher, the course does not allow for the teacher to always assign grades on the b 'correct" or "incorrect" answers so much as on the basis of how wel the student applies the systems approach to decision making. It follows that the entire team would do well to collaborate in evaluation for the purpose of assigning grades. Furthermore, important evaluation may come from the student himself. This can be elicited by the teacher in informal interviews with students.

After all, it is the student's personal assessment of the real world which is the focal point in evaluation. Respect for this assessment must not be lost in an effort to arrive at a letter grade designation. The teacher must simply face the fact that, ultimately, evaluation in The Man Made World is very subjective. Therefore, evaluation is increasingly more accurate when more teachers and students are involved.

3-6 Conclusion

The multi-disciplinary, team approach to The Man Made World is very unique and novel in public education. It seeks to provide a broad perspective from which to view the real world--not to draw the students to common conclusions. It seeks to foster divergent or creative thinking as much as convergent and analytical thinking. It seeks to individualize instruction and to build self-esteem as well as to foster tolerance and acceptance of other viewpoints. It seeks to meaningfully relate all facets of the students' academic and non-academic life experiences. As such it requires very unique and novel student-teacher interaction dynamics.

CHAPTER 4

Hints to Administrators and Team Members

4-1 Introduction

There are two distinct features of this course: first, the newness of concepts, objectives, and teaching methodology; second, the multi-disciplinary team approach. The fact that both of these features are present makes this course, at one and the same time, both exciting and challenging.

The course is exciting because it opens up new ideas and ways to approach learning, it provides opportunities for students to "take the initiative" in their learning process, and it provides for a new and different kind of student-teacher interaction than may normally be found in other courses.

The Man Made World is challenging and unique in implementation inasmuch as it doesn't really belong categorically in any traditional discipline field. This fact requires that those involved with the course give considerable consideration to such areas as budget, credit, staffing and scheduling. It is the intent of this section to anticipate some of the questions which will be asked by those implementing or considering implementation of The Man Made World on a multi-disciplinary team basis, as well as to offer some guidelines, hints, and possible suggested answers to these questions.

This section has been divided into sub-sections. The sub-sections include: planning and scheduling, budget considerations, course credit, selection of team members, and communications.

4-2 Planning and Scheduling

Perhaps there is no better way to insure the success of this course than to direct adequate attention to the planning and scheduling aspects. This is to suggest that not only is it essential to engage extensively in initial planning and scheduling, but also to continue to re-evaluate and plan throughout the year.

Because of the importance of careful planning, it is imperative that The Man Made World teaching team be provided a common planning time, when all members can be available. This planning time should be provided on a regular, and preferably daily, basis throughout the school year. Equally desirable, but somewhat less imperative, would be to provide each team member with some additional planning time, especially during the first year the course is taught. Unless additional time is provided, individual priorities, such as planning for other courses, may infringe on team planning time. This is a reality which should be considered by both administrators and team members when attempting to work out a schedule.

Closely related to the area of planning is the problem of scheduling and use of facilities. It is important that a joint decision be made by team and administration concerning scheduling format and class size. It is strongly urged that because of the nature of the student-teacher relationship, the activities of the class, and the purchase and use of equipment (see Chapter 6) that a maximum size of 25 students per teacher per class in a traditional schedule be strictly adhered to. If the multi-disciplinary approach is to be used effectively, it necessitates scheduling which permits all teachers involved in the course to be available to each class most,

if not all, of the time. Only in this way can the multi-disciplinary goals be fully realized. Division of the class within a common time block or class period should be left to the team and should be determined by the immediate goals and activities of the class.

This course lends itself well to the use of various size groups for instructional purposes (large group instruction, small group work and discussion groups, and individual work) if facilities permit this type of scheduling. If such facilities are not available or if scheduling difficulties preclude the use of various group sizes, then more traditional classroom groups may be effectively used, but never at the expense of "breaking up" the team, for then the multi-disciplinary aspect of the course is lost. The course also lends itself extremely well to the many forms of flexible scheduling. Activities, projects, lab work and student teacher contact is enhanced when extended time is provided.

It is also essential that room be provided on a regular basis for the use of equipment (analog computer and logic circuit boards). Any room with sufficient electrical outlets and work tables (not student desks) will suffice. Since small group discussions and work groups will be utilized, it is desirable to provide facilities which accommodate this activity.

Since there is considerable equipment which may be used in this course, consideration should be given as to storage facilities. It is desirable to store the equipment near the area where it will be used.

Because of the potential of this course to grow rapidly within a school, a word of caution about that growth is advisable. Growth of the course should be controlled and compatible with the availability of

trained teachers. Expansion of multi-disciplinary teams should also be carefully considered. See Chapter 5 of this guide for ideas concerned with training team members.

4-3 Budget

In considering budget for implementing The Man Made World, there are three major areas of concern. First, the total amount of money involved in original implementation; second, the yearly funds necessary to sustain the program; third, the department to which the budget is charged.

The total dollar amount involved in initiating The Man Made World can vary greatly depending on factors such as objectives of the course, student enrollment, scheduling, etc. The following suggestions may, however, help provide some guidelines as to possible costs involved in establishing the course.

The text for the course is entitled The Man Made World and is presently available from McGraw-Hill in a 3-part paper-back series. A one-volume, hard-back, revised edition is due to be published early in 1971. This revision is intended to encompass more of the multi-disciplinary aspects of the course than does the present three-volume edition. It is suggested that teams preview both editions and then decide which will best suit their program. It must also be decided whether it would be more desirable to purchase one book per student, or one or more classroom sets.

A minimum initial amount of equipment for a class of 25 students would be:

1 logic circuit board for every 2 students per section

1 demonstration analog computer

1 Cathode Ray Oscilloscope

The Man Made World project office has published a list of recommendations for additional equipment. It is essential that after the course has been taught the first time, the team give consideration to whether or not additional equipment is desirable for their program. Prices and lists are avialable from the project office (referred to in the Preface).

It is strongly recommended that ample funds be provided on a yearly basis (after initial funding) to allow the purchase of necessary reading materials and equipment. The course is designed to provide opportunities for students to engage in creating their own projects. Funds for such activities should be considered in planning a budget.

Films play an important role in this course and while many of the suggested films are available on a free loan basis, there are many that can be rented for a small fee. Film rental fees should be considered in planning a budget.

One of the best sources for audio-visual material for this course is television. Networks and ETV are now producing many excellent programs that add immeasurably to this course.

Because of the emphasis in this course on computers and computer technology, it is highly desirable though not essential to consider providing digital computer time for instructional purposes and student

designed programs. In some cases this will be virtually impossible. However, for schools who do have computer time available, it is advisable that some funds be set aside for the purchase of time sharing for this course, independent from other uses that may be present. The amount of time to be allotted for The Man Made World computer instruction and activity can be determined only by the people involved in the team and will depend in large part on the direction and emphasis of the course. Some teams will devote more emphasis to the computer aspect of the course than will other teams.

The third area of concern, that of departmental funds, may be best handled in one of two ways. First, The Man Made World budget can be shared equally or proportionally between all departments involved in the team. A second way would be to establish a separate budget for the course. The establishment of a separate budget would in most cases be preferable. A separate budget provides status and prestige to the course rather than making it appear that it must simply rely on the goodwill of the various departments.

4-4 Credit

One of the most perplexing and frequent questions asked about The Man Made World is the question of granting credits in a multi-disciplinary course. The amount of credit given poses no particular problem but the kind of credit and interpretation of that credit to those outside the school situation may need to be clarified.

Questions may be raised by uninvolved science teachers or uninvolved social studies teachers (or other fields) as to whether or not a credit should be given from that department for a course which has as its

thrust a multi-disciplinary approach. Probably the best way to resolve this feeling is for the team, in conjunction with involved department chairmen, to decide in the early planning stages what kinds of credit(s) can be earned by the student in the course. This will in large part depend on the direction and emphasis of course content, course objectives, and disciplines represented on the team. Once this is decided it is imperative that the decisions be explained and justified to all members of the departments involved, especially those not directly involved in the teaching of the course.

It may be desirable to examine the possibilities of multiple credits. Many schools have found it feasible and indeed desirable to let the student select the kind of credit he wants (i.e. science, social studies, business or other). Some schools have even gone to the point of dividing the credit so that the student may gain partial credit in two or more areas.

Because the course is multi-disciplinary and because it is an unfamiliar course to most people, problems may arise when interpreting transcripts to colleges and employers. One possible way to alleviate this problem is to provide a brief written description of the course and its content which may be attached to the transcript. This description should be written by team members and reflect the content and objectives of the course. If this method of explanation proves unsatisfactory, it is essential that some method be designed which will accomplish the same end.

It may be worth noting at this point that the North Central Association has observed many schools offering this multi-disciplinary course and to date has been very enthusiastic about the course and in most cases has gone out of its way to issue commendations. The question of credits has caused no concern on the part of North Central. Likewise, acceptance by colleges has been enthusiastic and in many cases colleges have encouraged the high schools involved to continue and even expand the program.

From its inception, most schools have taught The Man Made World as a laboratory-science course. The acceptance of the course in a broader multi-disciplinary sense is growing rapidly. The greatest assurance a school may have toward solving the credit and acceptance problem is to be certain all questions are answered and resolved by everyone involved in the course. With this kind of understanding and cooperation the issue of credits should be easily resolved.

4-5 Selecting Team Members

Perhaps the single most important factor in the success or failure of the multi-discipline course is the wise selection of teaching team members. Criteria and suggestions for the selection of the team are dealt with in Chapter 5 of this guide. It is imperative that this section be read thoroughly by all those concerned with the implementation of this course.

4-6 Communications

Acceptance of any course by the school and the community appears to be directly related to the communication which takes place between those involved in the course and those not involved. The same is certainly true to a larger extent because of the uniqueness of The Man Made World. The following suggestions and observations are offered concerning communications (a) within the school and (b) between the school and the community.

(a) Communications Within The School

Because of the newness of this course and because of the unfamiliarity in general concerning multi-disciplinary courses, communication between The Man Made World team and the other faculty members can be most beneficial. A short presentation or demonstration of the course content, objectives, and activities might be presented by the team members at a faculty meeting. A standing invitation for visitation of classes by any and all faculty members is another possible approach. Other methods may be devised by individual teams, but some effort in this direction is highly desirable.

If the course is successful in its attempt to "involve" students, the entire school staff must be willing to let the students become "involved." This means thorough communications must exist between all faculty members. Because this is a multi-disciplinary course, it is not at all inconsistent to involve every other teacher and subject area found in the school. Cooperation of teachers can easily be obtained on a personal basis, especially with the understanding that the student's experiences in both overlapping areas will be enhanced by this cooperation.

Because of the uniqueness of the course, it would be unusual for counselors to have the knowledge necessary for counseling students. It is essential, therefore, that a brief but thorough description of the course objectives and the type of student who will benefit from the course be made available to the counseling staff.

Counselors would also benefit from close communications because of the vocational aspects of The Man Made World. Since the scope of the course involves new and exciting vocational fields, the opportunities for meaningful vocational counseling are many and varied. With a sincere effort in this area by the team teachers and counseling staff, many students may find new direction in their thinking about future work.

(b) Communication Between the School and Community

The scope of The Man Made World makes it both necessary and desirable to establish communication between the school, the home, and the community. It has been observed by most schools that, with little effort, positive enthusiasm can be fostered on the part of parents and community. Much of the enthusiasm has resulted from positive acceptance by the community of student project work outside of school.

There are several other ways to communicate with the home and community. Such possibilities as letters, community newspaper articles and coverage about the course, student newspaper coverage, team members speaking at service organization meetings, PTA newsletters and meetings, and open house have all been successfully used by schools.

CHAPTER 5

Teacher Prearation

5-1 General Qualifications for Team Members

The multi-disciplinary, team approach to teaching The Man Made World is novel and powerful. For this reason, careful attention should be given to the formation of such a team.

The first, and overriding, requirement for team membership should be a genuine interest in innovative teaching and a willingness to meet the challenges that appear in a close student-teacher partnership. Other important considerations should include answers to such questions as:

> Are the backgrounds of prospective team members complementary?
>
> Are their personalities compatible?
>
> Can they establish rapport with students of different backgrounds and persuasions?
>
> Do they possess sufficient organizational ability to administer the activities of a number of students so that student and teacher time is utilized efficiently?

In the implementation of The Man Made World, almost any aspect of our real world may become "grist for the mill." For this reason, a rich background, conducive to a broad outlook, will better serve team requirements than would over-specialization in a single field of study. It must be re-emphasized, however, that attitude is as important as expertise on the part of team members. The decision-making process and the concept of modeling that underlie this course emphasize the systems approach to decision making. This approach discourages the use of expert or authoritarian "answers"

to the questions of today. Instead it encourages the student to reach his own decisions, based on the criteria and constraints of any particular situation.

Because of the emphasis on technology in our real world, it is highly desirable that at least one team member have a mathematical-scientific background. This criterion for team makeup results directly from the wide application of mathematical models today as evidenced by the mushrooming use of computers and related tools. In choosing the remaining team member or members, the chief guideline should be: The richer and more varied the backgrounds of the team members, the more powerful will be the resulting team. Inputs from many disciplines are vital if the overall objectives of the multi-disciplinary approach to The Man Made World are to be realized and if the team is to be truly multi-disciplinary.

Team size will depend on many factors, such as teacher availability, interest, scheduling problems and scope of course. By definition, a team approach must involve at least two teachers. However, it is urged that strong consideration be given to forming multi-disciplinary teams of more than two. While there is no maximum limitation on team size, caution should be used in order that the team not become so large as to be unwieldy. In school situations where flexible scheduling or modular scheduling are in use, a larger team may function more effectively than it might within the limitations of a rigid schedule.

In summary, the primary concern in selecting team members must be their willingness and enthusiasm toward teaching the course. It is strongly advised that no teacher be assigned to The Man Made World team without a thorough, though perhaps brief, exposure to the course

content and the systems approach it presents. The team members must be willing to accept the role of the teacher as a facilitator of learning, and the degree to which they can enthusiastically do this may affect the degree to which the course will succeed or fail. (See Chapter 3 for a more detailed discussion of the role of the teacher.)

5-2 Pre-Service/Pre-Degree Training

A. Math-Science Team Members

The requirements for mathematics or science degrees in most colleges and universities should provide adequate background for understanding most of the technical portions of The Man Made World. A year of calculus is necessary if proper appreciation for and full utilization of the potential of the analog computer is to be accomplished. Other areas in which course work or a basic knowledge of working principles will prove especially useful are:

Probability and Statistics
Symbolic Logic/Boolean Algebra
Computer Programming
Beginning Electronics/Electronic Circuits
Beginning Physics, Chemistry, and Biology
Ecology
Agronomy/Food Sources
Meteorology

In addition, a reasonable background in humanities will be most useful in promoting the melding of an integrated and effective team.

B. Social Science-Humanities Team Members

It would be difficult to overemphasize the importance of the roles of the social science-humanities members of The Man Made World team. Teachers with widely varied backgrounds and training are vital for adequate exploration of society-technology interactions. Experience or training in the following areas should prove especially useful:

Basic Cultural Anthropology
Social Change
Basic Economics
Group Dynamics
Communications

History of Sociological Thought
Cultural Geography
Semantics
Social Psychology
Sociology
History

From the foregoing lists of subjects it is apparent that valued team members can be recruited from any discipline. Let it suffice to say once again--enthusiasm and a genuine desire to explore the challenges of multi-disciplinary learning are the necessary qualifications for team members.

5-3 Post-Degree/In-Service Team Training

For a number of reasons, rather extensive training is needed to form a good multi-disciplinary team to teach The Man Made World. Even though all of man's activities involve decision making at some level, few persons ever go to the trouble of trying to learn just how the process works. The fact that a systems approach, with well-defined steps and procedures, can often be helpful in reaching optimum decisions in almost any situation will appear as a novel idea to both students and adults. Further, the multi-disciplinary approach to learning is so different, and the materials and objectives of The Man Made World so unique, that a three-phase special training sequence is recommended

as essential to successful implementation of these materials and methods by a team.

A. Phase One

Introduction to The Man Made World can best be accomplished with an inductive approach. The new teams are placed in decision-making situations similar to those they will eventually use with their own students. Thus they gradually acquire familiarity with the elements of decision making and experience the role of the student in a way that provides needed insights into the dynamics of student-teacher partnership.

It is recommended that this introductory training be accomplished in a series of three or four two-day workshops during the second semester of a school year, with sponsorship by a college or university and the granting of credit. It is further strongly urged that, for the most part, these workshops be planned and conducted by teachers with experience in the multi-disciplinary, team approach. The extended time blocks available in a two-day period make possible indepth activities and promote the free exchange of ideas between individuals and teams.

If college support and credit cannot be secured for Phase One Training, a participating school district may reasonably be expected to grant release time for workshop attendance and financial support for out-of-pocket expenses. Local in-service credit may also be granted to meet district requirements for teacher training where such requirements exist.

3. Phase Two Training

The primary purpose of Phase Two Training is to provide in-depth familiarization with all facets of The Man Made World materials and multi-disciplinary, team methods. A further purpose is to provide opportunity to see how multi-disciplinary activities are used in various disciplines and fields of technology and industry.

The multi-disciplinary, team approach will represent a considerable departure from a conventional classroom situation, so specific investigation of various methods of classroom teaching should be undertaken. Serious consideration should be given to possible teacher roles, such as, "first among equals," "resource person," and "referee," and to teaching situations which accommodate themselves to one or more of these roles.

A most effective learning technique, and one especially useful with The Man Made World, is the project method. Small student groups may be assigned to a project. Each small group has a specific area of investigation, but must interact closely with the other groups, separately and collectively, in order to complete the project.

The formation and direction of small interacting groups so that maximum involvement of every student is achieved is a prime responsibility of the multi-disciplinary team. Effective training for team members in this direction can be accomplished by using team projects as discussed below. Principles of group dynamics are most important, so it is recommended that considerable attention be given to this area.

A note of caution needs to be sounded here. The candid approach to the real world and invitation to personal involvement afforded by The Man Made World may elicit expressions of bias, religious beliefs.

moral principles and prejudice from students. Team members must school themselves not to get "up-tight" and to respect variant opinions, whether from students or other team members. Training in this regard should be a specific objective during small group sessions.

Another important part of Phase Two Training is thorough familiarization with the text materials, laboratory manuals, and laboratory equipment as provided by Engineering Concepts Curriculum Project. The extent to which these materials are used with students depends largely on the make-up of the multi-disciplinary team. It is essential, however, that the team reach tentative decisions on this subject during the course of summer training. In helping to reach these decisions, the input from experienced multi-disciplinary teams is vital. It is recommended that overall responsibility for this aspect of Phase Two Training be vested in such people.

Each multi-disciplinary team should be charged with developing a number of student activity projects. No other exercise will more quickly "jell" a team and develop an appreciation for the multi-disciplinary approach. Such projects can also provide a valuable addition to the growing body of team-produced resource materials available to teachers of The Man Made World. As they are produced, materials should be tested with other teams. Such team interactions provide important feedback for refining the materials as well as important inter-team dynamic experiences. Playing the student role also increases the team's capacity to identify with student groups.

A generous time allowance for investigation of and selective familiarization with resource materials as listed in Chapter 7 should

be provided. Copies of those books especially recommended for students should be on hand. Some of the better films should be used for course input during the Phase Two Training.

The systems approach to decision-making is being used more and more in fields where, at first glance, it would seem inappropriate. Leaders from these fields, through a special lecture series, can provide extremely useful input to the summer training. For example, people such as Kenneth Boulding, world-famous economist, Ed David from Bell Labs, and Igor Gamow, a noted research biologist, have made valued contributions to past training sessions by encouraging a multi-disciplinary systems approach and providing concrete evidence for the wide applicability of the concepts of The Man Made World to society.

C. Phase Three Training

New multi-disciplinary teams will find the inauguration of the course an exciting experience. The initial reaction of students is usually enthusiastic and there is little difficulty in getting off to a good start. Herein lies one of the challenges of The Man Made World: how to maintain the initial momentum? Effective assistance in meeting this challenge can be provided by further training through a series of two-day workshops over the first-semester period of actual team teaching. It is recommended that a three-or four-session workshop similiar to Phase One Training be implemented. If available, the same college or university sponsorship that sponsored Phase One and Two is desirable. By this time the team members will have already invested a great deal of personal time, and the granting of college credit will compensate for the additional

demands made upon them. It is the considered opinion of those who have "travelled the route" that Phase Three is well worth the time and effort that must be committed.

Phase Three should include use of the digital computer, experiences in group dynamics, and feedback sessions. The computer work should provide training in BASIC computer language and practice in the use of the digital computer as a universal modeling device. The place and use of the computer in The Man Made World is discussed in Chapter 7.

Since many student activities can best be carried out by small groups, some knowledge of group dynamics is an important asset for a multi-disciplinary team member. Phase Three training sessions provide additional experiences in this area.

Feedback to the sponsoring institution from the teams implementing the course is essential for improvement of the training. Equally valuable is the inter-team exchange of experiences, techniques, and activities that they have used. Reports of activities that didn't work and experiences that "bombed" may provide especially potent inputs. Careful group analysis of such "failures" may provide deeper insight into group dynamic processes by serving as exercises in this area. Comparisons with successful activities will help the teams identify techniques and approaches especially usable with small groups.

5-4 Sustained Training

In the course of the forming and preparing of the multi-disciplinary teams, increased awareness of professional kinship and

growth will develop. Promotion of this awareness can provide continued intra- and inter-team revitalizing. The team spirit can also prove infectious to colleagues and inject a new energy into school systems. Some means for providing sustained training might include occasional workshops, group meetings of multi-disciplinary teams at state and regional conventions, or simply local evening gatherings in areas where team concentrations make this feasible. The thrust for providing this further training will probably have to come from active multi-disciplinary teams themselves. The personal and professional dividends accruing from such efforts will be large indeed.

5-5 Training for Expansion of The Man Made World

The initial student response to The Man Made World when introduced as a new curriculum offering has almost invariably proved enthusiastic. This response encourages a rapid expansion of enrollment, which could be a detriment to the overall effectiveness of the course, if sufficient trained staff is not available. The wiser course is to carefully control the enrollment growth rate to one that can be effectively handled. Selection of students by team members and counselors will insure this control and, in addition, will help assure that students who can profit most from The Man Made World will be enrolled in the class. Close cooperation with the counseling staff is of course necessary.

As enrollment grows, provision must be made for training additional staff members. Ideally, the complete three-phase training outlined in the preceding sections provides the best means for thorough training and should be utilized when possible.

When complete training is not feasible, a practical alternative is to use on-the-job training by teaming a teacher new to The Man Made World with experienced team instructors. This method places an increased responsibility on the experienced team members, for which some form of compensation, such as reduced class load or released time, would be desirable. Inservice credit, if possible, for the new team member is also recommended.

Training of additional multi-disciplinary team members will not only provide a pool of instructors to handle expansion but will also produce unexpected dividends. No teacher can complete multi-disciplinary, team training without a heightened appreciation of, and respect for, other disciplines. Such respect can only increase staff unity and promote inter-discipline cooperation in the common educational effort.

5-6 A Proposal

An ideal solution to the problem of sustained training, and enhancement of the contribution of the multi-disciplinary The Man Made World to education in general, would be the establishment, on a regional basis, of some sort of clearing house or center. This center would act as a repository for field-generated ideas, techniques, student activities and resources. It would disseminate pertinent information on new developments in The Man Made World and

related programs. It would seek funding to provide new and sustained training for multi-disciplinary teams. Those presently engaged in or training for the multi-disciplinary, team approach to The Man Made World endorse and actively support such a proposal.

CHAPTER 6

Laboratory Use of Equipment

6-1 The Logic Circuit Board (L.C.B.)

One of the basic objectives of the course is studying the interaction of technology and society. The computer is one of the most significant technological developments of our time. It is producing changes in the society that have not been predicted and, if we are to better control the outcomes of computer application, it is mandatory that future citizens become familiar with computers.

Students need to be aware of the capabilities and limitations of the computer. Students need to be aware of the changes caused by the computer. Students need to be "computer-literate."

The Logic Circuit Board (L.C.B.) is a piece of hardware designed to model logic. It can be used to model parts of the computer and, therefore, make the computer, a man-made-machine, more understandable by students. By modeling logical situations and the various parts of a computer, the students gain an understanding that the computer is a machine to be used as a tool by man.

The Logic Circuit Board is an outstanding piece of equipment. Two major objectives can be experienced through the use of the L.C.B.: (1) man-machine interaction and (2) technology-society interface. It is recommended that the L.C.B. be an integral part of any multi-disciplinary approach to The Man Made World.

An inductive approach in teaching the L.C.B. is recommended. Students enjoy "learning by doing" on the L.C.B. The "and," "or" and "not" circuits are easily discovered. As students accomplish one task, another task of more difficulty should be provided. Such a list of student laboratory tasks follows in section 6-2. The L.C.B. can be used at any level of sophistication. It is not recommended that all students reach the same level of sophistication. A minimal standard may be required depending upon the emphasis placed on the L.C.B. in the course.

The L.C.B. is close to being student-proof and very seldom needs any repairs. However, a light or fuse may burn out. Since there are some students who want to take the L.C.B. apart and find out how it is made, it is suggested that the instructor select these students and let them change the fuses and lights. This will keep the L.C.B.'s functioning and provide opportunity to let students pursue their interest.

The L.C.B. is a modeling device and can be used to model different situations in real life. Students may want to model logical puzzles to see if they can find a correct solution to a given situation.

Students should be allowed to check out and take home the L.C.B. This will encourage students to maintain skills, to work on extra projects, and to make up work missed.

Students may want to demonstrate the L.C.B. in other subject areas. Because the L.C.B. models logic, it can be used in classes such as Electronics, Geometry, and Physics. The instructor should

point out these applications to the students. It is also recommended that the instructor of The Man Made World encourage the teachers and the other disciplines involved to demonstrate the common applications of the L.C.B.

It is recommended that an L.C.B. be provided for every two students. The early experiments use only one or two switches so be sure that both students are working on the board at the same time.

As students progress through the exercises the teacher will need to provide small group discussions in order to determine if the concepts were understood. If a student has repeated difficulty he should be referred to the text. Almost all the exercises are in the book and students can read along for extra information or to learn new concepts.

6-2 Typical List of Progressively More Difficult Tasks On The L.C.B.

Because of the varying abilities and interests of students, it is suggested they be given a list of modeling tasks, such as the ones below, to progress at their own rate. As soon as a student finishes one exercise he should go on to the next.

Set 1

1. Make a light go on using only one wire.

2. Wire a switch to a light so that the light is controlled by the switch.

3. Wire a switch to a light so the light is on only when the switch is in the operated (1) state.

4. Wire a switch to a light so that the light is on only when the switch is in the unoperated (0) state. This is called a "not" circuit. Why?

Set 2

1. Wire switch A and switch B to a light so the light is on only when switch A and switch B are operated.

2. Draw a diagram of the circuit you have constructed.

3. Build a table which shows all possible states of the switch in this circuit and the corresponding state of the light.

4. Rebuild the table using the symbol 0 to represent all unoperated switches and lights which are off. Also use the symbol 1 to represent all operated switches and lights which are on.

5. Is there a constant mathematical relationship between the values of the table? If so, explain the relationship.

6. Write a mathematical sentence which models this table.

7. Wire switch A and switch B to a light so the light is on when either switch A or switch B is operated.

8. Draw a diagram of the circuit you have constructed.

9. Build a table using 0 and 1 for the states of the switches and lights, which shows all possible states of the switches in this circuit and the corresponding state of the light.

10. Can you write a mathematical sentence using addition which models the table or do you need to define a new operation?

Set 3

1. Given the truth table below:

A	B	L
0	0	1
0	1	0
1	0	1
1	1	1

Does the equation $L = A + \overline{B}$* model this table? Why? Why not?

2. Wire a circuit on the L.C.B. which models the table in problem 1 above.

3. Draw a diagram of this circuit.

4. Given the truth table below:

C	D	L
0	0	0
0	1	1
1	0	0
1	1	0

Write a mathematical sentence which models this table.

5. Draw a diagram of a circuit which models this mathematical sentence.

6. Wire a circuit on the L.C.B. which models the table in problem 4 above.

*The bar above the B indicates not B. $\overline{B}$ = not B

7. Any logical sentence of the form "If A then B" has the following truth table where A and B are statements with truth value.

A	B	If A then B
False	False	True
False	True	True
True	False	False
True	True	True

Translate the table above into a table involving switches and a light. Represent statements A and B by switches A and B. Represent the sentence "If A then B" by a light. The truth value of a false statement is represented by 0. The truth value of a true statement is represented by 1.

8. Write the mathematical sentence for the table in problem 7.

9. Draw a diagram of a circuit modeled by the mathematical sentence in 8.

10. Wire a circuit on the L.C.B. which models the logic of any conditional sentence of the form "If A then B."

Set 4

1. A board of trustees of the Lart National Bank consists of three voting members. All loans must be approved by at least two of the board members. The members wish to vote in secret but wi... to know if any two or more members voted yes. Model this situation on the L.C.B. where members register their vote by operating a switch and a light comes on when two or more vote yes. This circuit is called the majority circuit.

2. A light in a stairway is controlled by two switches, one upstairs and one downstairs. Either switch can be used to turn the light on or off. When the light is turned on upstairs it can be turned off downstairs and conversely. Model this situation on the L.C.B.

3. There are two different circuits which can be used to control the light in problem 2. One is called a "two variable odd parity." The other is called a "two variable even parity." Which circuit do you have? Why?

4. Find the other circuit to control the light in Problem 2 and build a model of it on the L.C.B.

5. A pilot of a high-performance jet airplane has just lost part of a wing. He must eject, but two distinct steps are necessary. First, the cockpit canopy must be blown off; second, the seat (and he) must be ejected by another explosive charge. A straight forward method would be to fire the canopy charge with one switch and the ejection charge with another. But then, in

the confusion of the emergency, he might fire the seat first and be projected through the closed canopy. How can the switches be arranged so that regardless of the order in which the switches are operated, the first will fire the canopy charge and the second will fire the seat charge? Model the situation on the L.C.B. using two switches and two lights. One light represents the canopy charge. The other light represents the seat ejection charge.

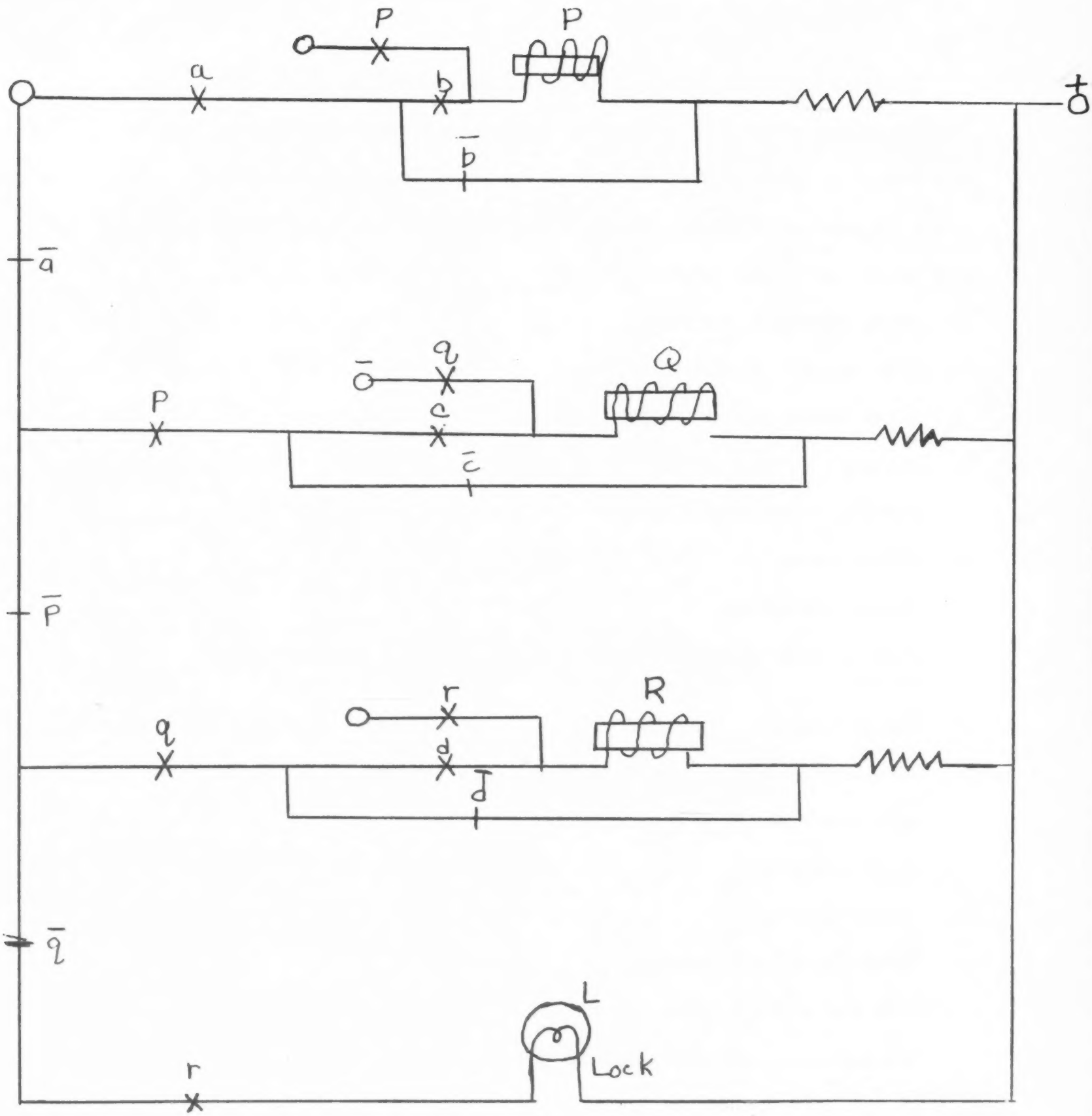
6. A boatman must carry a wolf, a goat and a cabbage across a river in a boat which is so small that he can carry, at most, one of them with him in it at a time. Moreover, whenever the wolf and goat are together, he must also be present to keep the goat from being eaten. Neither can he leave the goat with the cabbage. Model this problem on the L.C.B. so you can get all across the river without any being eaten. Use the switches to represent the boatman, wolf, cabbage, and goat. Use the two switch positions (0 and 1) to represent a disaster.

Set 5

The basic logical connections have been presented along with some modeling exercises in logic. The rest of the experiences are modeling parts of the computer. It is recommended that the order be used as follows, but only to the extent of the interest and abilities of the students.

1. Three variable odd parity.
2. Tree circuit (2 stage, 4 stage)
3. A two binary number comparitor.
4. One wire to make relay with a switch.
5. Control relay with a switch.
6. Binary adder
7. Binary subtracter
8. Wire as many unstable circuits as you can and draw a diagram of each.
9. Memory circuit
10. Addressable memory (four location)
11. Copy circuit
12. Shift register
13. Binary counter
14. Combination lock problem.

    Wire the circuit below on the L.C.B. Then, by maneuvering the switches, get the light to operate. When the light goes on you have opened the lock.


P
P
a
b
b
a
q
Q
P
c
c
P
r
R
q
d
d
q
L
Lock
r

6-3 The Analog Computer and the Cathode Ray Oscilloscope

The Analog Computer is a modeling device. The unique characteristics of the Analog are its integrating ability and speed which makes it very useful in modeling dynamic systems.

The Cathode Ray Oscilloscope adds the dimension of a more visible model. Students can see the dynamic situation they are modeling with the aid of an oscilloscope. By analyzing a situation, simulating it on the Analog, and watching the result on the CRO, the student gains an invaluable experience in modeling.

Because the Analog Computer is a more sophisticated modeling device and, therefore, more expensive, it is suggested that priority be given to the purchase of Logic Circuit Boards, rather than Analog Computers. If the Analog Computer is to be used extensively, it is suggested that one Analog be purchased for every four students. It has been the experience of the multi-disciplinary teams that students interested in mathematics and science perform better on the Analog Computer than non-mathematics and science students. Therefore, discriminate choice of situations to be modeled is absolutely necessary. The Analog Computer can be used to model situations as restricted as displacement with varying acceleration or as broad as world population. The use of the Analog should be determined by the objectives the team has selected for the unit.

The Analog also lends itself to the inductive teaching approach. It is suggested that students work on introductory experiments at their own rate. Then, after a workable knowledge is acquired, the students are provided with a variety of modeling situations so they can select those that more closely satisfy their needs. The revised

edition of The Man Made World has more inter-disciplinary exercises integrated in the course using the Analog.

Because of the sophistication of the Analog Computer, one of the team members must have a good workable knowledge of integral calculus. Experience in the past has shown that when an instructor is unsure of the outcome from the use of the Analog, students may not be fully motivated. Before the decision is made to use the Analog Computer be certain one member is confident in its use as a modeling device.

6-4 Digital Computer

In the multi-disciplinary approach, the greatest emphasis in the course is placed on decision-making in the real world. The digital computer is a universal modeling device. It can be used to model many aspects and problems of the student's own world, in fact, The Man Made World.

As the student models situations on the computer, some real insights into man-machine interactions can be developed. The student is encountering a complex physical system which responds to his symbolic knowledge and creates an experience in a way that makes this knowledge take on concrete meaning. The computer follows instructions exactly, but it is ruthless in demanding a corresponding consciousness and rigor of formulation in the instructions that it accepts.

Since The Man Made World is concerned with decision-making and modeling, the digital computer can be introduced as a universal model. The teaching of BASIC programming should be integrated with the development of the course. Appendix B of ECCP teachers guide (1967-68) lists programs and how to implement them as you progress through different decision-making experiences.

The course can also be taught without a time sharing terminal. It should be pointed out that even if a teacher does not have a terminal, but wishes to introduce his students to BASIC language, Appendix B should prove helpful. If so, it is recommended that more emphasis be placed on the CARDIAC so students can gain insight into the functioning and use of the computer.

Experience shows that the computer is such a motivating device that some students will be carried beyond the present understanding and achievement of the teachers. This should not concern the teachers. The teachers cannot be expected to have had previous experience with all of the computer models which students may construct. It is therefore recommended that the teachers consider themselves as resource persons rather than as authorities on the construction of these models.

6-5 Equipment Sources

For ordering information and prices on the Logic Circuit Boards and Analog Computers Contact:

American Machine & Foundry Co.
Alexander Division
1025 North Royal Street
Alexandria, Virginia 22314

CARDIAC s are available through the local business office of your Bell Telephone Company. They are free while the supply lasts.

CHAPTER 7

Resource Guide

The resource guide is divided into the sections shown below.

7-1. Introduction

7-2. Bibliography

- 7-2-1. Comparative Technologies and the History of Technology
- 7-2-2. Technology and the Human Condition
- 7-2-3. Technology and the Social Order
- 7-2-4. Human Ecology
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  - 7-2-4-3. Environment
  - 7-2-4-4. Pollution
- 7-2-5. Computers and Automation
- 7-2-6. Modeling
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7-3. Periodicals

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7-6. Slides, Television Shows, Games, and Kitchen Sinks

7-1 Introduction

This resource guide is designed primarily for teachers of The Man Made World. It does not purport to contain all the specific references and materials any one instructor would use in the teaching of this course, but it is intended to provide insight into the various areas that are an integral part of The Man Made World, especially in the multi-disciplinary approach. In addition, not only does the guide enumerate these areas, but it also suggests resource people and specific titles that will contribute substantially to any given topic.

The first section of the guide provides a bibliographic overview of the course. Perhaps nowhere else in the publishing industry is the "information explosion" so apparent as it is in the eight thematic regions, admittedly arbitrary, which are delineated in this bibliography. Consequently, the bibliography-as well as the other four sections-is "incomplete"; it is necessarily selective. But works that have been included are felt to be relevant enough, and, except in a few instances, recent enough, to justify their use over a long period of time.

Many of the books listed are for teacher preparation in the appropriate subject field, while some can be shared by students. Those books that are especially suitable for high school students are so designated by the symbol: (S). Titles that appear in paperback are also noted. Books recommended for student use, or felt to be of particular worth, are annotated. Also annotated are books ambiguous as to content, but it is hoped that the thematic divisions employed in the bibliography will guide the teacher to books that should help him. Even though the bibliography itself contains over 160 titles, no one section contains more than 20 references.

The rest of the guide is not subdivided thematically. The periodicals are all accessible, and many might be good choices for a high school library, depending on the emphasis given to the various subject matters in each Man Made World course. Only those magazines that can be counted on to contain articles applicable to The Man Made World are included. Specific articles have not been indexed because of their great number and their usual ephemeral nature due to constant up-dating.

The movies are all 16 mm., sound except where noted, and accommodate themselves well to high schools. The 21st Century series, which first appeared on CBS with Walter Cronkite, is especially recommended, particularly since many of these films are relevant to the multi-disciplinary approach and can be obtained free of charge. Attention is also called to the many excellent films without narration now on the market.

The people listed as resource possibilities are from Colorado, but men and women of like professions could provide equal insights into their own work. Just because someone is mentioned in this section does not, of course, indicate he is automatically available. Members of this writing team are themselves willing to talk with groups, to suggest other resources, or to help where we can in implementing and sustaining this course.

7-2 Bibliography

7-2-1. Comparative Technologies and the History of Technology

Armytoge, W. The Rise of the Technocrats. Routledge and K. Paul, 1965.

Elsner, Henry. The Technocrats. Syracuse University Press, 1967. Historical account of automation as the panacea of the 1930's.

Florman, Samuel C. Engineering and the Liberal Arts. McGraw-Hill, 1968.

Forbes, Robert James. A History of Science and Technology. Penguin Books, 1963.

Foster, George McClelland. Traditional Cultures, and the Impact of Technological Change. Harper, 1962.

Hughes, Thomas Parke. The Development of Western Technology Since 1500. Macmillan, 1964. (paper-1.95).(S).
Readings primarily for college students, but readable enough for better high school students.

Kranzberg, Melvin, and Carroll W. Pursell, eds. Technology in Western Civilization. Oxford University Press, 1967.

McLuhan, Marshall. Understanding Media. Signet, 1967. (paper-.95).(S).
An obtrusive but rather exciting theory of the importance of communication change on society.

Mead, Margaret, ed. Cultural Patterns and Technological Change. Mentor, 1966. (paper-.95).(S).
An anthropological study of how various pre-industrial societies have been affected by technological innovations. Difficult reading, but a good resource in this area.

Meier, Richard L. Science and Economic Development. M.I.T. Press, 1966.

Meynand, Jean. Technocracy. Free Press, 1969.
Originally published in French, the book provides an insight into the growing world of the technocrat.

Morison, Elting Elmore. Men, Machines, and Modern Times. M.I.T. Press, 1966.

Mumford, Lewis. The City in History. Brace and World, 1961. (paper-4.95).(S).
History and sociology of the cities from the paleolithic era to the suburbs. Long, but would be excellent resource for students.

Mumford, Lewis. The Myth of the Machine. Brace and World, 1967.
Subtitled "Technics and Human Development," this work purports to trace the rise of the influence of technique upon society. Non-Marxian interpretation.

Redfield, Robert. The Primitive World and Its Transformations. Cornell University Press, 1953. (paper-1.95).
Already a classic, this work assesses the importance of the urban revolution on pre-industrial societies.

Scientific American. Technology and Economic Development. Alfred A. Knopf, 1963.
The role of technology in the development of "non-industrial" countries receives primary concern in this book of readings.

Singer, Charles Joseph. A History of Technology. Clarendon Press, 1957.

Skinner, B. F. Walden Two. Macmillan, 1965. (paper-1.95).(S).
A novelistic account of Utopia, behavioral style. Makes good comparison studies with "real" society.

Whitte, Lynn Townsend. Medieval Technology and Social Change. Oxford University Press, 1967.

7-2-2. Technology and the Human Condition

Arendt, Hannah. The Human Condition. University of Chicago Press, 1958. (paper-1.25).

Baier, Kurt, ed. Values and the Future: The Impact of Technological Change on American Values. Free Press, 1969.

Brickman, William W., ed. Automation, Education, and Human Values. School and Society Books, 1966.

Burke, John G., ed. The New Technology and Human Values. Wadsworth Publishing Co., 1966. (paper-4.95).(S).
Book of readings on problems and prospects of technological society. Well-chosen selections.

Casserley, J. V. L. In the Service of Man. Regnery, 1967.

Dubos, Rene Jules. So Human an Animal. Scribner, 1968. (paper-2.45).(S).
An eloquent plea to stop acting like the last generation on earth. Rewarding reading for the student as well as for the teacher.

Ellison, Ralph. Invisible Man. Signet, 1953. (paper-1.25).(S).
A novel showing the plight of the Negro in urban society.

Ellul, Jacques. The Technological Society. Knopf, 1964. (paper-2.45).
Translated from the French, this book looks at the influence of technicians on our society, and finds it dangerous. Well-written, but difficult for students.

Ferkiss, Victor C. Technological Man: The Myth and the Reality. Braziller, 1969.(S).
Explores the impact of the machine and man's relation to it. A little difficult, but very valuable.

Fromm, Erich. The Revolution of Hope: Toward a Humanized Technology. Harper and Row, 1968. (paper-.95).(S).
The author sees technology as dehumanizing. He argues for a "humanized technology" that he feels can be achieved.

Fuller, R. Buckminster with Jerome Agel and Quintin Fore. I Seem to Be a Verb. Bantam, 1970. (paper-1.65).(S).
Typographically exciting book that presents many of Fuller's insights. This book could provide a basis for student awareness of their role in a technological society.

Hall, Cameron P. Technology and People. Judson Press, 1969.

Holland, John, ed. The Way It Is. Brace and World, 1969.(S).
Book of photographs taken by ghetto students of their world. Accompanying text.

Lewis, Arthur O. Jr., ed. Of Men and Machines. Dutton, 1960. (paper-2.25).(S).
Book of readings on man-machines interaction.

Nieburg, Harold L. In the Name of Science. Quadrangle Books, 1966.

Quinn, Francis X., ed. Population Ethics. Corpus Books, 1968.
Broad, non-denominational view of the population problem and its human implications.

Schon, Donald A. Technology and Change: The New Heraclitus. Delacorte Press, 1967.

7-2-3. Technology and the Social Order

Blaustein, Arthur I. and Roger R. Woock. Man Against Poverty - WW III. Vintage, 1969. (paper-2.45).(S).
Book of readings on the various aspects of poverty and the politics of poverty. Many selections difficult for high school reading.

Calder, Nigel. Technopolis. MacGibbon & Kee, 1969.(S).
Incisive argument that the people must demand that science enter the realm of politics.

Eldredge, H. W. Taming Megalopolis. F. A. Praeger, 1967. (paper-2.45).
There are two volumes of readings, the first of which deals with the problems of the city, and the second with the possibilities.

Fortune Magazine. Exploding Metropolis. Anchor, 1965. (paper-1.25).(S).
Essays on the various problems of an urban society.

Gist, Noel P. and S. F. Fava. Urban Society. Thomas Y. Crowell, 1964.
An urban sociology college text, the book is a clear, well-written introduction to urban ecology and is highly recommended for the teacher.

Guggenheimer, Elinor C. Planning for Parks and Recreation Needs in Urban Areas. Twayne Publishers, 1969.

Hardin, Garrett, ed. Science, Conflict and Society. Scientific American, 1969. (paper-5.75).(S).
Readings from SA on controversies arising from science's role in the modern world.

Jacobs, Jane. The Death and Life of Great American Cities. Random House, 1961.

Jeanneret-Gris, C. E. Le Corbusier (pseud.) The Radiant City. Orion Press, 1967.

Leinwand, Gerald, ed. Problems of American Society series. Washington Square Paperbacks, 1969. (each title paper-.75).(S).
The following titles are especially relevant to The Man Made World. Each book contains many photographs, and is designed for the layman.

_____. Air and Water Pollution.
_____. The City as Community.
_____. Crime and Juvenile Delinquency.
_____. Consumer.
_____. Negro in the City.
_____. Poverty and the Poor.
_____. Slums.
_____. Traffic Jam.

Lynch, Kevin. The Image of the City. M.I.T. Press, 1960.

McLuhan, Marshall. Counter Blast. Brace and World, 1969.

Mumford, Lewis. The Highway and the City. Brace and World, 1963. (paper-.75).(S).
First published in 1953, this book is still all too relevant in its plea for human-centered design.

Pursell, Carroll W. (comp.). Readings in Technology and American Life. Oxford University Press, 1969. (paper-2.45).

Scientific American. Cities. Knopf, 1965. (paper-2.45).(S).
12 essays on various areas of urban studies. Good studies into four world cities.

Theobald, Robert, ed. Social Policies for America in the Seventies - Nine Divergent Views. Anchor, 1969. (paper-1.25).(S).
Nine essays on different aspects of modern society, such as economic growth, poverty and education.

Von Eckardt, Wolf. A Place to Live. Delacorte Press, 1968.

Wingo, Lowdon, Jr. Cities and Space: The Future Use of Urban Lands. Johns Hopkins University, 1963.

Wright, Frank Lloyd. The Living City. Mentor, 1963. (paper-1.25).(S).
A plea by the famous architect to unite nature and the city. Illustrated, the book was first published in 1958.

7-2-4. Human Ecology

7-2-4-1. Population

Benjamin, Bernard. Demographic Analysis. Frederick A. Praeger, 1969.
Short manual explaining demographic methods to the general reader.

Borgstrom, Georg. The Hungry Planet. Macmillan Co., 1965. (paper-2.95).(S).
Special emphasis on the gap between well-fed and undernourished peoples of the world.

Carey, G. W. Teaching Population Geography. Teachers College Press, Columbia University, 1969.

Cook, Robert C., and J. Lecht. People! An Introduction to the Study of Population. Columbia Books, 1968. (paper-1.50).(S).
Originally prepared for secondary schools but suitable for general readers.

Ehrlich, Anne H. and Paul Ehrlich. Population, Resources, Environment: Issues in Human Ecology. W. H. Freeman & Co., 1970.

Ehrlich, Paul R. The Population Bomb. Ballantine Books, 1968. (paper-.95).(S).
Emotional account of our growing population crisis. Has much to say for it, not least of which is the fact that students enjoy reading it.

Fisher, Tadd. Our Overcrowded World. Parent's Magazine Press, 1969.(S).
World population growth seen in broad perspective. Readable.

Freedman, Ronald. Population: The Vital Revolution. Doubleday, 1964. (paper-1.95).(S).
A collection of 19 essays, concerned mainly with demographic processes and population trends for specific regions and for the world as a whole. Clear and nontechnical.

Hardin, Garrett. Population, Evolution, and Birth Control. Scientific American, 1969. (paper-2.95).(S).
Articles from SA on general topic of population. Also includes selections from world literature on population.

Hauser, P. M. Population Dilemma. Spectram, 1968. (paper-1.95).

Heer, David M. Readings on Population. Prentice-Hall, 1968.
Nontechnical readings.

Heer, David M. Society and Population. Prentice-Hall, 1968.
Brief textbook.

Hertzberg, Hazel W. Teaching Population Dynamics. Teachers College Press, Columbia University, 1965.

Malthus, Thomas R. On Population. Modern Library, 1960.
First published in 1798, this two-volume work revolutionized the study of population, and its effects are still apparent today. Surprisingly easy reading, at least in parts.

Wrong, Dennis H. Population and Society. Random House, 1967. (paper-1.95).(S).
Traditional recounting of population studies, but readable and understandable.

Young, Louise B., ed. Population in Perspective. Oxford University Press, 1968. (paper-4.95).(S).
Presents short selections on population from writers in many disciplines.

7-2-4-2. Man-Land Relationships

Beaujeu-Garnier, Jacqueline. Urban Geography. Wiley, 1967.

Borgstrom, Georg. Too Many. Macmillan Co., 1969.

Clark, Colin. Population Growth and Land Use. St. Martin's Press, 1967.

Cloud, Preston, Chairman. Resources and Man. Scientific American, 1969. (paper-2.95).(S).
Nontechnical book on the problem of diminishing resources and accelerating population.

Dickinson, Robert E. City and Region: A Geographical Interpretation. Routledge and Kegan Paul, Ltd., 1964.

Doxiades, K. A. Ekistics. Hutchinson, 1968.
An introduction to the study of human settlements, this large work on ekistics, the science of human settlements, is heavily illustrated.

Getis, Arthur and Judith Getis, eds. "Urban Geography Issue", The Journal of Geography. 45, May 1966.

Glabb, Charles N. The American City: A Documentary History. The Dorsey Press, 1963.(S).
Several of the essays in this collection contain material on urban population growth and distribution.

Murphy, Raymond E. The American City. McGraw-Hill, 1966.

Schneider, Wolf. Babylon Is Everywhere: The City as Man's Fate. McGraw-Hill, 1963.(S).
Translated from the German, the book purports to be a history of the city. Good photographs.

Taylor, Thomas Griffith. Urban Geography. Methuen, 1968.

Weber, Max. The City. Collier Books, 1962. (paper-.95).

Zelinsky, Wilbur. A Prologue to Population Geography. Prentice-Hall, 1966. (paper-1.95).
A tentative but perceptive exploration of the nature, scope, structure, and methods of population geography.

7-2-4-3. Environment

Benarde, Melvin A. Our Precarious Habitat. Norton, 1967. (paper-3.95).

Carson, Rachael. Silent Spring. Houghton, Mifflin, & Co., 1962. (paper-.75).(S).
Famous work that saw the dangers of DDT and other pesticides.

Dansereau, Pierre. Challenge for Survival: Land, Air, and Water for Man in Megalopolis. Columbia University Press, 1970.
Technical, but rewarding.

Dasmann, Raymond F. A Different Kind of Country. Macmillan Co., 1968.
Plea for the preservation of natural and man-made diversity against the pressures of technology and population growth.

Forbes, Robert James. The Conquest of Nature. Praeger, 1968. (paper-1.25).

Hawley, Amos H. Human Ecology. Ronald Press, 1950.(S).
Although 20 years old, this well-written introduction to the study of population in an ecological framework is still very worthwhile. A clear, nontechnical work, it is highly recommended for teachers, with many passages appropriate for students.

Helfrich, H. W., ed. Environmental Crisis. Yale, 1968. (paper-1.95).(S).
Readings on the dangers of pollution and over-population.

Herfindahl, Orris Glemens. Quality of the Environment. Johns Hopkins Press, 1965.

Milton, John, M. Loghi Farvav, eds. The Careless Technology. Natural History Press, 1970.
Modern developmental technology is reviewed in terms of its effects on the environment.

Osburn, Fairfield. Our Plundered Planet. Pyramid Books, 1968. (paper-.75).(S).
First published in 1948, now an even more relevant study of diminishing resources.

Park, Charles F., Jr. Affluence in Jeopardy. Freeman, Cooper and Co., 1968.

Shepard, Paul and Daniel McKinley, eds. The Subversive Science. Houghton, Mifflin Co., 1969. (paper-5.95).
Selected essays on human ecology.

Sierra Club. Ecotoctics - The Sierra Club Handbook for Environmental Activists. Washington Square Paperbacks. (paper-.95).(S).
"How to" stop pollutants and polluters. Incisive reading.

Theodorson, George A., ed. Studies in Human Ecology. Row Peterson and Co., 1961.
A very comprehensive anthology of readings in human ecology.

7-2-4-4. Pollution

Briggs, Peter. Water, The Vital Essence. Harper & Row, 1967.
Discussion of present water supply throughout the world.

Carr, Donald E. The Breath of Life. Norton & Co., 1965.
Analysis of air pollution from carbonaceous fuels, its chemistry and effects.

Commoner, Barry. Science and Survival. Viking Press, 1966. (paper-1.35).(S).
Discusses how science has polluted our world and threatened our survival, and suggests alternatives for citizens. Hard hitting and very readable.

Goldman, Marshall. Controlling Pollution: The Economics of a Cleaner America. Prentice-Hall, 1967. (paper-1.95).(S).
Nontechnical readings on the politics of pollution control. One section explores the Soviet approach in this area.

Grava, Sigurd. Urban Planning Aspects of Water Pollution Control. Columbia University Press, 1969.

Herber, Lewis. Crisis in Our Cities. Prentice-Hall, 1965.

Leinwand, Gerald, ed. Air and Water Pollution. Washington Square Paperbacks, 1969. (paper-.75).(S).
See annotation in 7-2-3.

Lewis, Howard R. With Every Breath You Take. Crown Publishers, 1965.

Nader, Ralph. Summer Study Group Reports. Grossmann, 1969. (each title paper-.95).(S).
The following titles arose from "Nader's Raiders'" reports on various subjects.

_____. Dead Air.
_____. Dry Water.
_____. Interstate Commerce Omission.
_____. Sawing the Wind.

Packard, Vance. The Waste Makers. Pocket Books, 1957. (paper-.75).(S).
A readable account of our solid waste problem, and how industry contributes to it.

U.S. Department of Commerce, The Automobile and Air Pollution. A Program for Progress. Superintendent of Documents. Washington D. C., 1967.

7-2-5. Computers and Automation

Bagrit, Sir Leon. The Age of Automation. Mentor, 1965. (paper-.60).(S).
Explores the influence of automation on business. Somewhat simplistic.

Brightman, Richard W. Data Processing for Decision-Making. Macmillan, 1968.

Cote, Alfred J. The Search for the Robots. Basic Books, 1967.(S).
Traces the technology of automata.

Diebold, John. Man and the Computer. F. A. Praeger, 1969.(S).
Here the author is concerned with the role of technology as an agent of social change.

Favret, Andrew G. Introduction to Digital Computer Application. Reinhold Publishing Co., 1965.

Foster, David Blyth. Automation in Practice. McGraw-Hill, 1968.

Goodman, Leonard Landon. Man and Automation. Penguin Books, 1957. (paper-.95).(S).
English assessment of the impact of automation on modern society.

Nikoloieff, George A. (comp.) Computers and Society. H. W. Wilson Co., 1970.

Porter, Arthur. Cybernetics Simplified. Barnes and Noble, 1970. (paper-1.50).(S).
Overview of feedback and servomechanisms.

Sackman, Harold. Computers, System Science, and Evolving Society. Wiley, 1967.

Scientific American. Automatic Control. Simon & Schuster, 1955.
SA overview of computers and information theory. For better students interested in this field.
_____. Information. W. H. Freeman, 1969. (paper-2.50).(S).

Seligman, Ben B. Most Notorious Victory: Man in an Age of Automation. Free Press, 1966.

Simon, H. A. The Shape of Automation for Man and Management. Harper Torchbooks, 1966. (paper-1.45).

Singh, Jagjit. Great Ideas in Information Theory, Language and Cybernetics. Dover, 1966. (paper-2.25).(S).
Covers information theory in the context of computer-brain isomorphism. Good source book for teachers and more advanced students.

7-2-6. Modeling

Ackermann, Robert J. Modern Deductive Logic. Anchor, 1970. (paper-1.45).(S).
An introductory work that math-oriented students will enjoy.

Cohen, John. Behavior in Uncertainty. Basic Books, 1964.

Diesing, Paul. Reason in Society. University of Illinois Press, 1962.

Manheim, M. L. Model Building and Decision-Making. M.I.T. Press, 1962.

New York City Museum of Modern Art. The Machine as Seen at the End of the Mechanical Age. 1968.
Exciting book that has hundreds of illustrated examples of the machine as seen by the artists.

Rapoport, Anatol. Prisoner's Dilemma.(paper-2.95). University of Michigan Press, 1965.

Rapoport, Anatol. Two Person Game Theory. University of Michigan Press, 1966. (paper-2.45).
Short book on game theory, specifically on such theory with decisions in conflict situations. Mathematical background helpful to understanding.

Sypher, Wyle. Literature and Technology: The Alien Vision. Randon House, 1968.
Interesting reading on the effects of technology and technological change upon literature.

7-2-7. Systems Analysis and Decision Making

Boguslaw, Robert. The New Utopians, A Study of System Design and Social Change. Prentice-Hall, 1965.(S).
Short book that touches on many topics covered in The Man Made World, especially modeling and decision-making.

Davenport, William Henry, ed. Engineering, Its Role and Function in Human Society. Pergamon Press, 1967.

Diebold, John. Man and the Computer. Praeger, 1969.(S).
See annotation in 7-2-5.

Fortune Magazine. Guide to the Quantitative Age. Holt, Rinehart, Winston, 1966.

Fuller, R. Buckminister. Operating Manual for Spaceship Earth. Southern Illinois Press, 1969.

Kurtz, Paul W. Decision and the Condition of Man. University of Washington Press, 1965.
Purporting to be an essay in naturalistic philosophy, this book gives insight into the philosophical underpinnings of decision-making.

McMillan, Claude. Systems Analysis: A Computer Approach to Decision Models. R. D. Irwin, 1968.

Perrucci, Robert, ed. The Engineers and the Social System. Wiley, 1969.

United Nations, Chemical and Biological Weapons and the Effects of Their Possible Use. Ballantine, 1969. (paper-1.25).(S).
Study of the system of non-explosive weapons and the possible consequences of their use.

7-2-8. Future of the Technological Society

Ayres, Robert U. Technological Forecasting. McGraw-Hill, 1969.

Boulding, Kenneth. Meaning of the Twentieth Century. Harper&Row, 1967. (paper-1.45).(S).
Especially recommended preview of the technological society and projections of its future.

Calder, Nigel, ed. The World in 1984. 2 vol. Pelican, 1969. (paper-1.25 each vol.).(S).
Readings especially from Continental authors on divergent subjects that will mold our future.

Cetron, Marvin J. Technological Forecasting. Technology Forecasting Institute, 1969.

Columbia University. Technological Innovation and Society. Columbia Press, 1966. (paper-.95).

Fuller, R. Buckminister. Utopia or Oblivion. Bantam Books, 1969. (paper-.95).

Kahn, Herman. The Year 2000. Macmillan, 1967.
The systems approach to speculation. Some exciting ideas, but rather too difficult for student use.

McHale, John. The Future of the Future. Braziller, 1969.(S).

Mesthene, Emmanuel A. (comp.) Technology and Social Change. Bobbe-Merrill, 1967.

Peccei, Aurelio. The Chasm Ahead. Macmillan, 1969.

Prehoda, Robert W. Designing the Future. Chilton Book Co., 1967.

Wallia, C. S., ed. Toward Century 21. Basic Books, 1970.(S).
Based upon a symposium entitled "Technology and Human Values," this book of readings deals with various areas of the technological society and the possible changes to be seen in the future.

7-3. Periodicals

American City, The
Municipal management and engineering monthly. Provides technical material for student research.

American Forests

Aviation Week and Space Technology

Bulletin of the Atomic Scientists (Science and Public Affairs)

Center Magazine, The
Published by the Center for the Study of Democratic Institutions.

Computers and Automation
Interesting articles on the current applications of the computer.

Consumer Reports

Demography
Some articles of interest to the general reader.

Engineering Opportunities

Environment
Well documented articles on man's disruption of his environment.

Focus

Journal of Marriage and the Family
Articles on family size, birth rates, child spacing, attitudes toward fertility and many other areas.

Land Economics

Man on Earth
Essays on human ecology.

Natural History
Articles on natural phenomena, ecology.

Population Bulletin
Issues and interprets facts about population trends.

Population Index
Technical review of the literature.

Psychology Today

Public Interest

Science and Technology
Hard to obtain but worth the effort.

Scientific American
The September 1970 issue is to be devoted to technology and the environments and is especially recommended.

Social Forces

Trans Action
Problems of modern society from a social science standpoint.

Technology Review
Special issues on subjects associated with The Man Made World.

Urban Affairs

War-Peace

7-4. Films

Air Pollution - Take a Deep Deadly Breath, 54 min., color

America on the Age of Abundance, 60 min., b/w

A Million Years of Man
Introduction to Anthropology, 24 min., color

Atomic Medicine (21st Century), 26 min., color

At Home, 2001 (21st Century), 25 min., color

A Trip from Chicago (21st Century), 25 min., color

Autos, Autos Everywhere (21st Century), 25 min., color

Banquet of Life (NET), 60 min., b/w

Bats, Birds, and Bionics (21st Century), 26 min., color

Bulldozed America, 50 min., color

Can We Live To Be One Hundred? (21st Century), 26 min., color

City, The - Cars or People?, 28 min., b/w

Cities of the Future (21st Century), 25 min., color

Class of '01, The - The College of Tomorrow (21st Century), 25 min., color

Communication Explosion, The (21st Century), 25 min., color

Four Day Week, The (21st Century), 26 min., color

From Cradle to Classroom (21st Century), 2 parts, 26 min., color

Futurists, The (21st Century), 25 min., color

God Within, The
Traces the Origins of Modern Science, 21 min., color

Heart of the City, 28 min., b/w

How Do Things Look? (21st Century), 26 min., color

Industries of the Future (21st Century), 26 min., color

Invader , The, 29 min., b/w
Presents the life cycle of the salmon and demonstrates how their existence is threatened by dams on the rivers, water pollution, etc.

Jonas Salk - Science of Life (21st Century), 26 min., color

Man-Made Man (21st Century), 25 min., color

Medical Electronics (21st Century), 26 min., color

Miracle of the Mind (21st Century), 26 min., color

New Land for Old, 20 min., b/w

New Weapons Against Crime (21st Century), 26 min., color

Noise - The New Pollutant, 30 min., b/w

No Room for Wilderness, 25 min., color

Our Vanishing Lands, 24 min., color

Poisoned Air, 50 min., color

Population Ecology, 19 min., color

Population Explosion, 43 min., b/w

Population Explosion, 15 min., color

Population Problem (series - NET), 30 or 60 min. versions, b/w

Remarkable Schoolhouse, The (21st Century), 25 min., color

Shape of Films to Come, The (21st Century), 25 min., color

Silent Spring of Rachael Carson, 54 min., b/w
discussion of Silent Spring

Standing Room Only (21st Century), 25 min., color

Third Pollution, 19 min., color
describes America's solid waste problem

U.S.A.: Time for Decision (NET), 60 min., b/w

Voice of the Desert, 22 min., color
conservation studies

Water Famine, 54 min., b/w

7-5. Resource People

Beidelman, Richard - Colorado College Biology Professor. Ecology.

Birmingham, John - Colorado State Senator. Population.

Boulding, Kenneth - University of Colorado Economics Professor.
Decision-Making.

Cameron, Robert - Denver Urban Renewal Association.

Downing, Sam - Past Medical Director of Planned Parenthood, Denver.

Gamow, Igor - University of Colorado Engineering.

Gardner, Lee - Audubon Society Ecological Consultant.

Kurtz, Maxine - Director of Denver Model Cities Program.

Lamm, Richard - Colorado State Representative, President of First
National Congress of Environment and Population.

Plant, Frank and Arnold Alperstein - Jefferson County lawyers.
Implications of social change.

Ray, John - Health Physics Department, Dow Chemical.

Ten Eyck, Tom - National Resource Co-ordinator, Colorado.

Villars, Jerry - Colorado Department of Education learning techniques
consultant and media specialist. Familiar with The Man Made World.

Weiner, Ruth - Temple Buell Chemistry Associate Professor. Human ecology.

7-6. Slides, Television Shows, Games, and Kitchen Sinks

The open-ended nature of this course allows for a multiplicity of resources, engendered by imagination and the willingness to innovate by both the teacher and the student. Herein are included some of these possibilities.

Slide presentations can be of benefit. These can be produced by students themselves or a school can purchase pre-packaged programs such as the New York Times filmstrips. The Times offers the following programs of special applicability to The Man Made World:

Crisis of the Environment
Economics
The Cities: People and their Problems
Problems of Democracy
Contemporary Problems

Bell Telephone also provides material of this type, especially in the computer field.

Television is obviously a source of great benefit. Regularly scheduled programs and specials provide numerous applications to The Man Made World, so much so that it is suggested the class keep abreast of current offerings by checking TV listings at least a week in advance. NET publishes its schedule a year in advance, and this ready source of information should be obtained. If the school has a video-tape recorder, some programs might be video-taped for later use.

There are on the market many games that model topics covered in The Man Made World. "Dangerous Parallel," produced by Scott, Foresman, simulates decision-making in the political science area, and is a good example of the kind of game that can be employed. So too, is "Starpower," a game developed by Simile II (1150 Silverado, La Jolla, California), that is used to provoke discussions about the uses of

power. The technology and marketing games included in the appendix of this guide model yet other types of activity.

It must be stressed in conclusion that the titles in this guide are, after all, only suggested resources. No one teacher would want to "cover" all of the myriad topics listed, just as, it is hoped, no one teacher would want to limit himself to only the possibilities presented. The nature of The Man Made World should be such that only a lack of student interest or a lack of relevance to each course's objectives will limit exploration into any one area.

Appendix

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I. Title of Unit:

HUMAN FEEDBACK IN PROBLEM SOLVING

II. Instructional Objectives:

A. Student will design and use alternative feedback systems.
B. Student will identify the importance of feedback in human interaction.
C. Student will recognize that feedback is necessary in a controlled, goal seeking, dynamic system.
D. Student will realize that feedback may take varied forms.

III. Rationale of Unit:

Feedback is a critical concept of the course and this activity serves well to convey and illustrate this concept.

IV. Instructional Procedures:

The activity requires 2 students. One student will be blindfolded, the other is instructed to make no vocal sounds and/or gagged.

The participants are then asked to leave the classroom. Meanwhile, the teacher explains the activity to the rest of the class, vis. a study of feedback.

A simple task is then selected, the performance of which requires a cooperative effort on the part of both participants. For example, they must balance a coffee can in the middle of an eight foot 2 x 4 board, pick the board up at either end and lift the board over their heads.

The student without speech is then brought back into the room and the task is explained thoroughly to him. He is instructed that at no time during the task may he have bodily contact with his partner. The blindfolded student is then brought into the room and the activity begins. With no more elaboration the challenge is for the 2 participants to establish sufficient communication and feedback to perform the task.

A word of caution: the rest of the class must be clearly instructed to provide no inadvertent feedback in the form of laughing, whispering, shuffling and the like.

Optional Procedures

Alternative tasks may be designed by the teacher and/or student.

An additional blindfolded student may be involved. This student is not required to perform the task and in fact does nothing more than serve as interference in the feedback system.

Two separate teams may be utilized to perform the same task at separate times in order to compare feedback systems which each develops. It is necessary that the 2nd team does not observe the 1st team perform.

V. Student Assessment

A. A follow-up discussion should identify the apparent elements of feedback which the 2 students employed.

B. The non-participating students are asked to individually write 3 alternative means by which feedback could have been established. Divide the class into small groups and have students analyze each others alternatives.

VI. Description of Instructional Materials and Equipment

A. One eight foot 2 x 4 board
B. Coffee can
C. blindfold
D. gag (optional)

I. Title of Unit:

AN EXERCISE IN MODELING AND GROUP COMMUNICATIONS

II. Instructional Objectives:

The students will be able to:

1. Construct a diagram of how the parts they have listed are arranged inside the box.
2. List their observations and identify the senses they used.
3. Compare their observations with those made by other members of the team and defend or reject them based on re-evaluation and experimentation.
4. Demonstrate the need for control in an experiment by keeping one of the team boxes intact.
5. Use verbal descriptions, analogies, metaphors, symbolic models, physical objects, and non-verbal expressions to communicate among team members.
6. Describe the difference between observation and inference using examples drawn from this modeling exercise.
7. Suggest several ways in which the irreversibility property of pulling out the rods parallels real-world situations.
8. Describe their feelings when they were told that they could not open the box.
9. Discuss the relationship of this emotion (8) to that of scientists, engineers, and city planners who are faced with not being able to "open the box" in real-world situations.
10. Use the team model to predict the outcomes of a new experiment on the black box.

III. Rationale of the Unit:

The concept of modeling is one which is basic to every field of science and engineering. This activity provides the opportunity for students to approach a problem as a team and to give their answer in the form of a model (symbolic or physical) of the interior of the box. This model should help the students realize the need for modeling real-world situations, especially those which might involve irreversible processes when experimented with.

IV. Instructional Procedure:

The class should be divided into four to six man teams. Each member of the team will be given a "black box" with the following instructions given to the entire class:

"Your team is expected to reach a consensus on and describe your model of the contents of these boxes to the other teams in

the class. You may investigate the boxes in any way available to you, except, by opening them. Warning-the removal of a rod may cause an irreversible process to occur inside the box.

All of the boxes are identical and only a very few additional samples are available. These samples may be obtained by carefully describing the plan you have for using them."

After making this brief statement and passing out the boxes the teacher(s) should become a passive observer of the student's activities. This can be a very inductive exercise but the students should be made aware of the broad objectives of the activity so as not to feel that they are simply playing a game.

After five minutes you should remind them that the task may require team cooperation and that they should develop a research-team strategy based upon their individual observations and inferences thus far and team experiements they might need to try.

At this point the teachers should begin asking questions which will help the teams if they seem to be immobilized by the situation.

After about twenty minutes, a class or small group discussion should be conducted to bring out the processes of observing, inferring, and making hypotheses. Examples of first approximation models which each person or group is using should be shared and discussed. (The teams may find it helpful to utilize the the overhead projector and transparencies to show their symbolic models to each other.)

The teams should then be allowed time to re-evaluate their model inlight of the larger evidence now available. A final written report from each team should include their model and supporting evidence. This model may be in the form of a descriptive narrative, schematic picture, or a physical box with network of wires and objects.

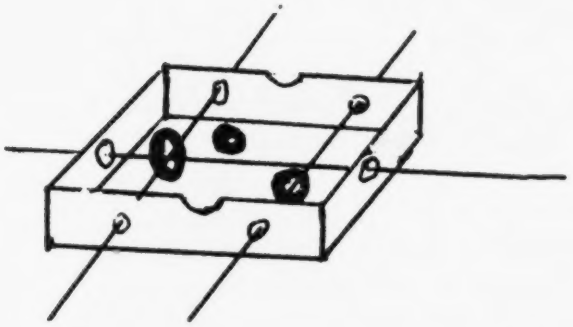
A final discussion should follow the collection of the still unopened, sealed, boxes. This discussion should bring out the irreversibility concept. It should also investigate how the students felt at not being able to open the box and check their models. Real-world parallels such as atomic models, electrical models, solar system models, and gene models should illustrate the possible frustrations faced when it becomes necessary to rely on models for information and application of natural phenomenon.

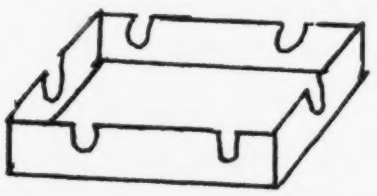
V. Student Assessment

The objectives (II) are stated in such a way as to suggest possible individual assessment of students' observable performance during this activity. The suggested group reports (IV) will also provide information useful in assessing the progress of the team in their modeling.

VI. Instructional Materials & Equipment

The black boxes used in this activity and the basic idea for the procedure were developed by the Introductory Physical Science (IPS) Project. The boxes are available from Damon Scientific, or MacCalaster Scientific Co., both producers of IPS equipment. Similar boxes could be made locally.





Other types of black boxes are described in The Chemistry Study Program, Models for Electricity and Magnetism Science Curriculum Improvement Study, Berkley, California, and many others.

In addition to the black boxes (one for each student plus 5 or 6 extras), the teacher should provide other materials unobtrusively available to students who wish to construct a physical model of the black boxes. Such things as: coat hangers, boxes, erasers, springs, paper clips, coins, pieces of wood, . . .

I. Title:

SIMULATED MINING TECHNOLOGY IN THE CLASSROOM

II. Instructional Objectives:

A. The student will experience practice in decision-making.
B. The student will use divergent thinking.
C. The student will experience man-machine interface.
D. The student will realize the importance and the realm of feedback.
E. The student will participate in a dynamic modeling experience.

III. Rationale of Unit:

A. This activity provides a capsule overview of most major concepts found in the course, and may serve as an excellent course introductory activity.
B. This activity is useful for illustrative purposes as the course progresses.
C. This activity is a useful vehicle for testing course concepts at a later date.
D. This activity serves as an excellent motivational device.
E. This activity introduces students to their peers and teachers and provides opportunity for class to get to know one another.

IV. Instructional Procedures:

A. Duration of Game

Because of the scope of this game, about 5 class meetings should be allowed for completion.

B. Object of Game

Students must devise a technology which they will use in a classroom simulated mining activity. Teams will compete in designing more efficient technological operations. This is measured by the number of finished products each team consumes.

C. Teams

(i.) Students work in teams of six.

(ii.) Each team will be divided into two groups of three. One group will be designated "workers" and the other "observers." Each team will play the game at least twice so that the two groups may alternate roles.

D. Game Instructions

1. Divide the classroom into 5 equal rectangles (as shown on diagram at the end of this section) and delineate with masking tape or chalk marks.

2. Each 6-member team should decide which 3 members will begin as "workers" and which 3 will begin as "observers". (These roles alternate each time the game is played.)

3. The working group is then divided with each person serving a function corresponding to the 3 areas on the diagram, i.e., miner, refiner and consumer.

4. It is the function of the "observers" to watch all teams perform in order that they may seek ways to improve their own team's performance the next time the game is played.

5. The "mining area" (see diagram) is where "deadly radio-active ore" is found. The ore consists of approximately 75 paper brads (fasteners) which are inserted through corrugated cardboard and fastened. Each team is to have its own exclusive mine.

6. The function of the miner is to remove these brads ("ore") from the corrugated cardboard without touching them with any part of the body. If at anytime he touches the brads directly, he is immediately disqualified for a duration of 2 minutes. There will be no substitutions. After removing the brads, he must then somehow transport them across the 1st chasm to the refiner.

7. Both chasms in the playing area are bounded by sheer cliffs which are impassable. Any human or physical object touching the chasm is considered to have fallen in and is lost forever.

8. The function of the refiner is to "refine the ore" by placing a washer on the brad such that the washer will not fall off at anytime thereafter. Seventy-five washers will be provided by the teacher before the game begins. This is designated as a "finished product". If at anytime the refiner touches either the washer or the brad (both of which are radioactive) with any part of the body, he is immediately disqualified for a duration of 2 minutes. No substitutions are permitted. After refining the product, the refiner must then somehow transport the finished product across the 2nd chasm to the consumer.

9. The function of the consumer is to utilize the finished products in an atomic plant for a large utility company. In order to do this he must re-insert the finished product into a corrugated cardboard such that the washer will not fall off the brad and the brad will not fall off the cardboard. These will be designated "consumed products." If at any time the consumer touches the refined product with any part of his body, he is immediately disqualified for a duration of 2 minutes. No substitutions are permitted.

10. Each 6-member team is to devise its own technology to play the game. The team may use any devices which will fit into but not protrude above the top of one large grocery bag. There is to be only one bag per team. Teams must be given ample class time to plan their technology and at least one day in which to collect and assemble devices necessary to implement that technology.

11. The recommended time limit for playing each game is 10 minutes. The winning team is the one who has "consumed" the most products.

12. Each team is to play the game on at least 2 different occasions and the groups (i.e., "workers" and "observers") must alternate roles each time the game is played. There should be an interim of at least one day between games in order that the teams may re-group to consider modifications of their technology.

E. Optional Instructional Procedures - Catastrophes

This game is of such a nature that it lends itself to considerable flexibility in rules, procedures and playing situations.

One highly recommended variation of the game involves the the use of "catastrophes." This variation should be used only after the teams have had the opportunity to play the game at least once. The use of catastrophes is important because it forces the team to revise their technology <u>during</u> the game, where previously they revised it <u>between</u> games. This more closely models the unpredicted events of the real world. It necessitates immediate improvisation and thereby encourages the teams to design a more flexible technology and to think divergently. Catastrophes should be such that they change the manner

in which one or more of the workers performs his function. To illustrate, consider the following examples:

1. loss of one or both thumbs on the part of one of the workers. This may be simulated by taping the thumb to the palm of the hand.

2. loss of one or both hands

3. loss of one or both arms

4. loss of one or both legs

5. loss of vision

6. loss of speech

7. a disruption in the technology such as the loss of any wheels, pliers, string, and the like.

After the 1st game is completed and before the teams re-group to modify their technology, they should all be informed that during the next game some catastrophes may randomly occur. The teacher may or may not wish to divulge the types of catastrophes.

After the 2nd game is well under way, catastrophes may be randomly distributed. Randomness may be achieved by the throwing of dice, flipping of a coin or drawing of cards. In order to avoid excessive confusion, the number of catastrophes which occur should not exceed twice the number of teams involved.

V. Student Assessment

Due to the introductory nature of this activity, it is strongly advised that the teacher not attempt to assign quantitative grades to the students. Rather it is critical that the students themselves identify all of the major concepts found in the instructional objectives of the game. A follow-up class discussion may be used to achieve this. Some guidance may be required from the teacher in the form of probing questions. The teacher may later find reference to this game helpful for illustrative purposes when presenting the concepts of decision-making. Alternatively the teacher may later test the student's comprehension of the concepts of decision-making by requiring that they relate those concepts to this game.

VI. Description of Instructional Materials and Equipment

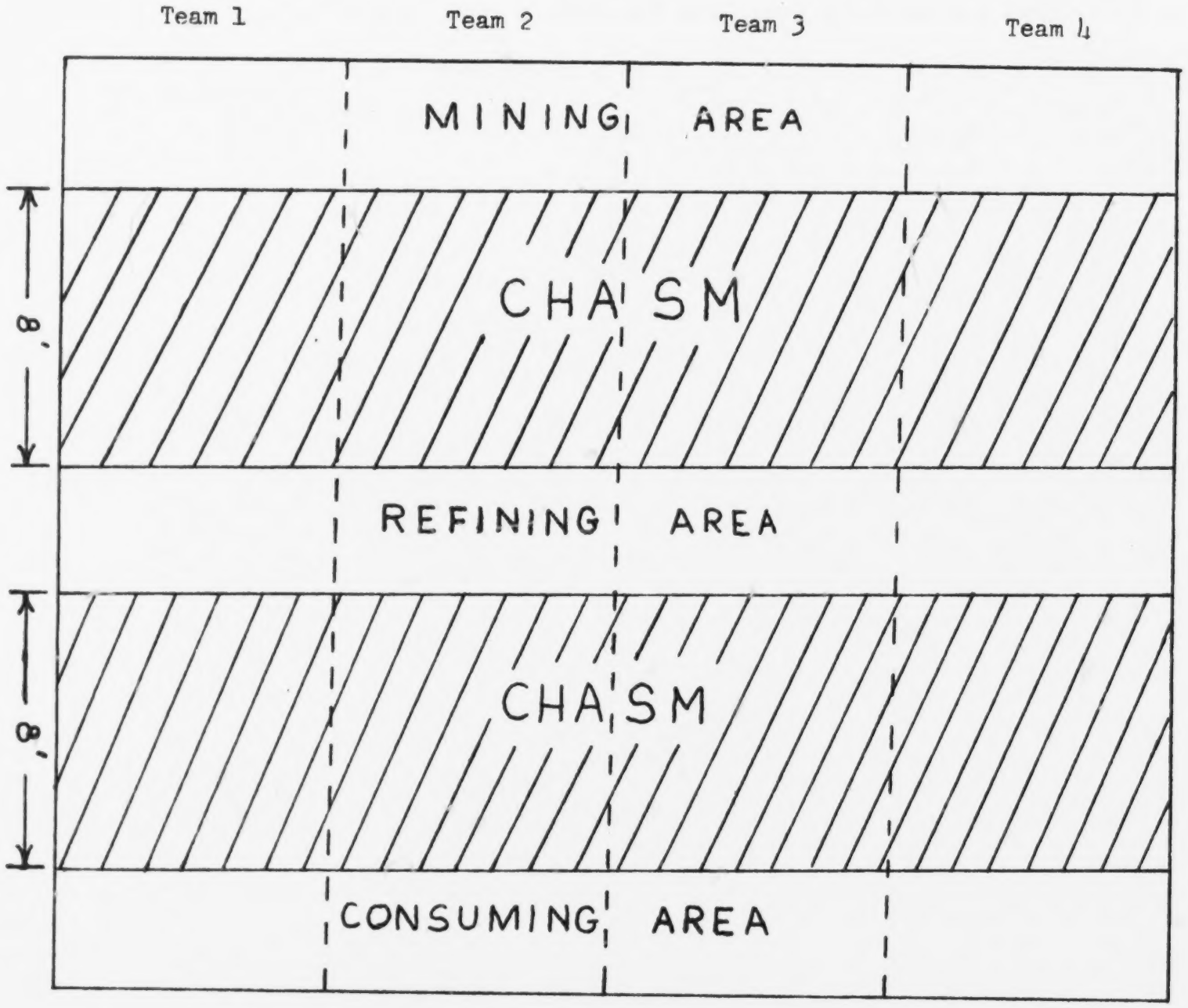
1. Two corrugated cardboards for each team

2. 75 brads (paper fasteners) per team

3. 75 washers per team (The washers must be of such size that they will fit into the shank of the brad but will not pass over the head of the brad.)

CLASSROOM DIAGRAM

(Suggested Classroom Arrangement For Simulated Mining Technology Game)



* Desks may be placed in the designated chasm areas for convenience and/or an added obstacle.

* It is imperative that the chasms be a minimum of 8 feet wide to prevent the students from directly handing products and/or devices to one another. The width of the working area is immaterial.

I. Title of Unit:

INTERIOR DEPARTMENT DECISION CONCERNING
THE GLENWOOD CANYON OF COLORADO[1]

II. Instructional Objectives:

The student will:

A. Develop techniques for collecting data on a real-world system.
B. Collect data on the real-world system.
C. Analyze the reliability of data collected.
D. Identify constraints in the real-world system which limit the area of feasible solution.
E. Formulate criteria for the decision.
F. Identify conflicting criteria in the decision.
G. Establish priorities on criteria.
H. Model the real-world system.
I. Make a decision which is optimum under the priorities established.

III. Rationale of Unit:

A. The unit provides opportunity for students to work with an interesting real-world decision problem.
B. The unit provides students opportunity to apply a systems approach to decision making to a real-world system over a period of several days.
C. The unit provides opportunity for students to participate in a small group interaction experience.
D. The unit provides opportunity for each student to work on aspects of the decision which are of interest to him personally.
E. The unit provides opportunity for the total class to participate in self evaluation, with each student evaluating the work of other students and himself.
F. The unit provides opportunity to involve students from another course such as Journalism or Language Arts with students from The Man Made World in activities which are valuable to both.

IV. Instructional Procedures:

A. After The Man Made World class has some exposure to the systems approach to decision making, divide the class into small groups of from three to five members. Provide each student with a copy of the problem definition and simulated testimony in section VI.

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[1]While this exercise is based on a real world situation it is intended as a classroom simu[illegible] Therefore, the names of people and companies are fictitious. Wh[illegible] testimony may reflect attitudes of real people, it is also fic[illegible]tious. This was done to avoid direct reference to real persons or companies.

The package will answer most of the students' questions about their task. Explain that their work will be evaluated by other students at the end of two weeks.

B. Allow from three to seven days of class time for students to gather information about the system and to build models. During this time it is suggested that the teacher play a passive role, spending most of the time observing the degree to which students apply a systems approach to their task. The teacher should, however, observe how many of the following areas of investigation each group pursues. While the list is not exhaustive, it will provide teachers with some guide to areas of possible investigation by students.

1. Economics and process of sugar refining.
2. Economy of the city of Delta, Colorado, and its relation to the sugar industry.
3. Shipping and transportation economics.
4. Natural ecology of the area.
5. The Colorado State economy and its relation to the sugar industry.
6. National and state mining laws and regulations.
7. Chemistry of sugar refining.
8. Activity of private groups and state agencies in the area of preservation of scenic beauty.
9. Problems of unemployment in the state.
10. Traffic problems associated with increased highway usage by trucks.
11. Effect of mining operations on local and state tax structures.
12. Esthetics of the region.
13. State and local welfare financing and distribution.
14. Relation between sugar consumption and the ban on cyclamates.
15. Social and demographic characteristics of the towns of Delta and Glenwood Springs.

C. Allow a few days for preparation of group reports.

D. After a maximum of two weeks, each group should report to the "Secretary of the Interior" at a public hearing held in front of the other students. Each group should present and justify its decision. (It would be valuable for each group member to participate in this reporting in relation to his own area of investigation.)

*E. Invite a different group of Journalism students in to observe and write a news article about each group's report. The Journalism students should have no previous information about the problem. After each news article is written, give it to the corresponding reporting group to read. This well serve as feedback mechanism for the group. Bring student decision makers and Journalism students together for discussion of the article, focusing on the accuracy of news reporting.

*(optional)

V. Student Assessment:

A. After all groups have reported to the "Secretary" at a public hearing, ask each student to rank-order the groups from most to least effective. Ask each student to explain his reasons for ranking the top group and the bottom group.

B. Give each student a list of the student performance objectives for this unit. Ask each to rate himself on a Likert scale as to whether or not he displayed these behaviors during the exercise.

VI. Instructional Materials:

A. Problem Definition Package for Students:

This is a simulated proceeding under section 2 of the act of August 11, 1955, Colorado Statute 681. The act authorizes, subject to certain conditions and limitations, the location and patent of mining claims on public lands. Section 2 of the act authorizes your group to decide, on behalf of the "Secretary of the Interior", the degree to which certain placer mining operations should be allowed. The act specifies that your group must arrive at one of six alternative decisions by consensus. Once your decision is made, it will be enforced by executive order of the "Secretary of the Interior." After that time neither the Secretary nor the members of your group will have opportunity to change the decision.

Your group must decide the degree to which placer mining shall be allowed on public land contained in two mining claims known as Elephant Rock Extension and Elephant Rock No. 2. In order to supply minimal background information and to define the problem, you are provided with simulated testimony from a variety of groups including the Colorado Bureau of Land Management, the Ace Trucking Company, the Isaac Walton League, the Association of Landscape Architects, the Delta Colorado Junior Chamber of Commerce, the Jolly Sugar Corporation, the Colorado Open Space Coordinating Council, the American Mining Institute, the United Mine Workers AFL-CIO, and the Association for Beautiful Roads. It is the responsibility of your group to uncover additional information related to this question.

The two mining claims cover approximately 135 acres and are situated approximately 15 road miles east of Glenwood Springs, Colorado, along the north rim of Glenwood Canyon. Elephant Rock extension is at the eastern entrance to the canyon. Elephant Rock No. 2 is about one airline mile further west in the canyon. United States Highway 6 follows the river along the bottom of the canyon. The highway lies near the southern boundaries of the two claims although at a much lower elevation, on the north side of the Colorado River. The Denver and Rio Grande Western Railroad passes through the canyon on the south side of the river at approximately the same elevation as the highway.

Glenwood Canyon is an area of scenic river country, largely undisturbed except along the bottom lands immediately adjacent

to the Colorado River. Among its scenic attractions are vertical limestone cliffs that rise over 1,000 ft. above the floor of the canyon.

The two claims were located for the purpose of removing, by quarrying operations, chemical-grade limestone. The limestone is to be used in processing beet sugar into table sugar. Limestone outcrops in almost sheer cliff faces along most of the southern and eastern portions of the Elephant Rock Extension. Back from the cliff faces to the north and west, the limestone on the Elephant Rock Extension is covered with overburden. Most of the limestone that outcrops on the Elephant Rock No. 2 is in the north half of the claim. The rest of the land involved in the Elephant Rock No. 2 allegedly contains either no limestone, or limestone that could not be economically mined because of overburden and faulting.

The statute under which your group was formed allows you to act only once. You cannot issue a decision now relative to mining and then issue a conflicting order at a later date. You must select one and only one of the following six alternative decisions:

1. Complete prohibition of placer mining.
2. Permission to engage in placer mining on the condition that the locator shall, following placer operations, restore the surface of the claim to the condition in which it was, immediately prior to those operations.
3. Permission to mine any and all limestone, except that portion running inland for 100 ft. from the canyon edge, leaving a wall of limestone 100 ft. thick with the face of the canyon wall intact.
4. Permission to mine up to X tons of limestone in any calendar year, the value of X to be set by your group.
5. Permission to mine limestone with the provision that the purchaser of the limestone, Jolly Sugar, pay the State of Colorado X dollars per ton, the value of X to be set by your group, the income to be divided between the State Game and Fish Department and the State Highway Department.
6. Permission to engage in unrestricted placer mining.

You have a total of two weeks to investigate this situation and make your decision. Remember the decision must represent a consensus of your group. At the end of that time your group must be prepared to report to the "Sevretary of the Interior" and justify your decision at a public hearing. The quality of your work will be judged by the public.

B. Simulated Testimony for Students:

Lewis M. McGinn - Zoologist - Colorado State Game and Fish Department.

"The mining claims lie within what is designated as the critical winter range of a game management area. The game management

area covers 138,240 acres and contains 11,700 acres of critical winter range. There are roughly 1,000 head of deer and between 500 and 700 elk in the management area. The average annual kill over the past three years by hunters in the area has been 746 deer, and 278 elk. The browse on the approximately 135 acres covered by the claims is typical of the critical winter range area."

John P. Hertz - Mining Engineer - Colorado Bureau of Land Management.

"Due to the high quality of the limestone it must be assumed that 95% of the two claims would ultimately be mined, thus disturbing approximately 128 acres."

Alfred T. Coons - Senator - Colorado Legislature

"In the 1968 session of the Colorado Legislature, a resolution was adopted by the Senate and the House of Representatives which recognized the unique scenic character of Glenwood Canyon. The resolution stated in part:
'. . . the Glenwood Canyon of the Colorado River is well known throughout the Nation as being one of the most splendid natural features of the State of Colorado. It is one of the scenic landmarks of the State that is most enjoyed and appreciated by the people of the State and is one of the major natural features that makes Colorado an outstanding state for tourism.'"

Joe T. Shifty - Truck Driver - Ace Trucking Company

"Coming west from the town of Dotsero, I can see, barely just make it out on the horizon, this ledge that extends out toward the river. Suddenly there is a hill between me and the ledge so it can't be seen. As I round the bend and go into the canyon from the mouth, still going west, I can look up quickly and see the limestone outcrop."

William L. Gorky - Geologist - Urad Mining Company

"Generally speaking, in the southwest quarter of Elephant Rock No. 2 there is a series of two faults which have dropped the limestone down resulting in too much overburden to mine economically. Somewhere between 40 and 60 acres could be mined economically. Approximately 15 acres would be disturbed at the surface."

Dean A. Builder - Mining Engineer - American Mining Institute

"There is no reason that competent mining engineers could not come in and leave a wall of rock with all cliff faces intact. There would be some engineering required but it could be done."

Marvin Conklin - Zoologist - Consultant to Jolly Sugar

"Mining operations on the two claims probably would not affect the elk because they winter a little bit higher. Assuming vegetation was removed from between 200 and 300 acres as a result of mining operations somewhere between 100 and 200 head of deer probably would have to be reduced to maintain that herd within its carrying capacity on that range. In arriving at this reduction figure, the removal of vegetation is of prime importance. The removal of the forage is the number one factor and if the north 80 acres of the Elephant Rock No. 2 were not taken into consideration, the 100 to 200 head reduction would have to be adjusted downward to at least half. If the 24 acres in the southeast corner of the Elephant Rock No. 2 were also removed from consideration, there would be further downward adjustment in the estimated reduction of deer. Activity in connection with limestone quarries has not, in the experience of Jolly Sugar, noticeably affected the wildlife in the area of the quarries. In any event we do not anticipate that there would be any mining activity on the two claims during the winter time when the deer would be in the area."

Bill Barker - Chamber of Commerce - Delta, Colorado

"At the present time a large percentage of the work force in Delta is employed in a capacity directly related to the sugar industry. Elimination of this industry would bring undue hardship on the citizens of our community. It is imperative that our economic climate be maintained and the rights of our citizens be protected. We cannot afford to lose our main industry due to the lack of a simple mineral such as limestone."

James T. Fergusen - President - Colorado Open Space Coordinating Council.

"Glenwood Canyon is a famous national phenomenon which is unique from the standpoint of scenic beauty. Any quarry operation on the visible cliffs of limestone would be extremely detrimental to the scenic quality of the entire canyon. This is the gateway of the canyon, and the impression created here on anyone going from east to west is going to be lasting clear through the canyon. If the Elephant Rock No. 2 were quarried clear to the southern boundary, there would be an extremely detrimental effect to the scenic quality of the canyon. Damage to the scenic value of Glenwood Canyon resulting from mining or quarrying the two claims would be

very material. There are presently about 5,080 people per day that go through the canyon. Even if the cliff faces were left intact, the removal of the overburden above and behind the cliff would have the same detrimental effect on the scenery as the removal of the cliff faces."

Richard M. Hixon - President - Jolly Sugar Company

"The limestone deposits on Elephant Rock Extension and Elephant Rock No. 2 are the only ones of this quality within economic reach of our company. All limestone deposits closer to the plant are of inferior quality not suitable for sugar refining. The next closest deposit of high quality limestone is 200 miles away near Fort Collins. Use of limestone from this location would cause price increases in our product which would make it impossible for us to compete with other companies. Our supply of limestone is dwindling to such an extent that we will be forced to close down all operations in the Delta area if this new supply is not made available."

Alfred E. Newman - Colorado State Economist

"The sugar industry in Colorado is one of the most important in the economy, following tourism and cattle. Income from the sugar comprises a large portion of our state revenues.

"Without the availability of the limestone in Glenwood Canyon it would be necessary to seek limestone from Fort Collins or possibly the San Luis Valley. This would result in a greater expense to the sugar industry and would significantly reduce the state government revenues. Furthermore, consumer prices on sugar products in Colorado would increase drastically."

Sam Jarvis - Mayor - Delta, Colorado

"The city of Delta is very dependent on the Jolly Sugar Company for its economy. Removal of the sugar plant from our community would place many people on the unemployed roles. There are very few other job opportunities available for these people. Such a situation would place a tremendous economic burden on the county welfare department. Even if only half of these unemployed sugar workers went on relief, there would still be considerable increase in welfare expenditures. There is not sufficient tax base in the whole county to support such welfare expenditures.

"If the sugar plant is allowed to close, our town will experience the same rapid death which occurred in the copper-mining towns of Arizona. This means a disruption in the lives of several thousand. We cannot allow this to happen."

Carl T. Bentz - Executive Secretary - Association for Beautiful Roads

"Glenwood Canyon is and has been historically recognized as a unique scenic area. Any excavation or mining in the area covered by Elephant Rock Extension would have a detrimental effect on the canyon and would cause material damage to the scenic values of the canyon. Material damage would result because the claim is at the entrance of the canyon and first impressions are lasting. With one exception there are no other excavations directly visible from the highway. In-so-far as Elephant Rock No. 2 is concerned, mining operations would be visible from the highway. If the cliff of limestone was removed from Elephant Rock Extension the change in character of the terrain would be visible from the highway to somebody intimately knowledgeable of the profile. If there were limestone on the southern portion of the Elephant Rock No. 2 and if it were mined, operations would be visible."

Alfred Dunn, State Naturalist - Slippery Rock, Pennsylvania

"The restoration of stip coal mining areas in the State of Pennsylvania has been accomplished by holding a mineral severance tax in escrow to be used for the restoration. The restoration seems to be esthetically acceptable and suitable for the total ecology. This plan could also be used in Colorado."

George M. Schultz - Geologist - U.S. Department of the Interior

"The presence of deep cracks in the limestone cliffs would make a 100 ft. thick wall of limestone unstable. Cracks would widen due to expanding ice. This coupled with the force of the Colorado River at the base of the cliffs would quickly destroy such a remaining structure."

Thomas T. Thomas - Wildlife Biologist - Isaac Walton League

"Mining operations on the two claims would result in a reduction of the deer and elk herds in the area and affect the use of the area for hunting. There would be two factors involved. One would be the direct removal of the forage. The other, would be the activity involved in making this area unavailable to animals."

Fred J. Spinster - Vice President - Jolly Sugar Company

"The general intention of the corporation is to extract minerals from the sites under consideration in a manner which will minimize the defacement of the area, and, to this end, to require operators

to conform to this policy. The present intentions of the company will not change with changes in company leadership."

John L. Lewis - President - United Mine Workers AFL-CIO

"There are over 250 skilled miners unemployed and living within a 50 mile radius of Glenwood Springs. These men are unemployed due to previous reductions in all mining operations in the area. They are available for work and would provide the necessary labor for the limestone quarry."

Dr. John Little - Interested Party

"Even if the claims were mined under the proposal where the cliff faces would be left intact there would be damage to the scenery. As a geologist, with some experience in limestone quarrying, I am assured that the exercise of any of the presently known limestone quarrying techniques on the massively bedded Leadville Limestone that forms the very visible cap rock on the north side of the canyon wall, would be a generally unattractive operation, impossible to conceal, either during or after quarry operations, and necessarily highly disruptive of the natural landscape as it now exists. The canyon would in time undergo further degradation via natural erosion and mass-wasting of the scarred surface."

Fats Fountain - Economist - National Sugar Institute

"With the federal ban on cyclamates in in foods and beverages, the United States will experience a rapid increase in the consumption of sugar. If a severe shortage of this fundamental food is to be avoided, additional sugar refining facilities must be built and in operation within a very short time.

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I. Title of Unit:

MARKETING DECISIONS INVOLVING A NEW PRODUCT
IN AN INDUSTRY OF SIX FIRMS

II. Instructional Objectives:

The student will:

A. Practice decision-making techniques in a simulated situation.
B. Experience participation in a dynamic system.
C. Identify the characteristics of a competitive economic system.
D. Identify the characteristics of a computer-modeled situation.
E. Construct a model of a dynamic system.
F. Describe forms of communication in a group situation.
G. Describe forms of communication between competitive groups.
H. Experience feedback in a dynamic system.

III. Rationale of Unit:

Providing students with a situation within which they can practice decision-making techniques is the basic idea of the market simulation. It provides students with a dynamic situation in which they can be observed employing the decision-making system. Through the excitement of competition and motivation for profit, the instructor can observe whether or not students will use decision-making as an effective tool in a real-world situation.

The marketing simulation provides students with a diversified activity away from the text book. He experiences feedback in a dynamic situation. He is given the opportunity to model, react to feedback, and use many varied techniques which have been or will be provided in The Man Made World.

IV. Instructional Procedure:

A. Suggestions to Teachers:

The listing of the marketing program for a Hewlett Packard computer, programmed in BASIC language, is found in section VI. To use this simulation as effectively as possible you must know some things about the program. (The program can easily be translated into other computer languages.)
The marketing simulation is written so students make as many decisions as the teacher wishes. It is recommended that

approximately twelve decisions be used. No more than twenty minutes of class time should be necessary for a board of directors to reach a decision, except on the first decision which will require more time. After the decisions are made and run through the simulation, the results for a particular team should be given to that team captain. One decision a week is recommended for 12 weeks. After about four weeks, information of all firms can be distributed to the group. Again after 8 weeks the information can be distributed to all groups.

The largest determinate of the market is price. When providing input to the computer always organize the teams by lowest price as team 1 to the highest price which would be team 6. The program is written so four teams may have the same price. It makes no difference which of these teams is listed first.

The only control the teacher has over the direction of the game is through the variables of total market and production cost per unit. It is suggested that the market be expanded. When the game begins the total market is 30,000 units. As prices go lower the total market should get larger. Also, the "gidget" is a new product and the market will get larger with acceptance.

If, for example, the game is for one year or 12 decisions, a typical list of total markets would be; 31,000; 34,000; 38,000; 44,000; 50,000; 55,000; 55,000; 52,000; 46,000; 40,000; 39,000; 39,000. The "gidget" is a new product which becomes very popular for a short time and then the market shrinks back and stabilizes.

The cost of production will not vary significantly. The trend should be for a little higher cost of production as the game progresses. However, the teacher could bring in an event, such as, the workers are considering striking for higher wages, which would drive cost of production higher. A typical list of production costs per unit would be: .50; .50; .51; .52; .525; .55; .55; .555; .56; .56; .565; .57.

The input necessary to run the program is price, amount produced, amount invested in plant, surplus, plant capacity, and cash-on-hand for each team. The first three inputs, price, amount produced, and amount invested in plant, come from the students decision. The remaining information will be taken from the output of the previous decision. This requires the teacher to keep records of each firm. It is mandatory that the teacher keep a student record sheet on each team. This sheet is contained in section VI.

As the market expands, the teams will find it difficult to meet their potential possible market. It is possible for firms to overproduce. But the more a firm over-produces the more it costs to produce additional "gidgets". This is written into the program. After the game is about half finished a discussion of over-production would be helpful.

If the firms do not forecast their production accurately and have a surplus of "gidgets" they will be charged extra for the storing of the surplus. Accurate sales forecasting should be a prime consideration. Because of obsolescence, firms must reinvest in the plant to maintain or improve production capabilities. It is more difficult to increase production by investing in plant than by over-producing. Investing in the plant will not penalize a team, because of the method of determining the winner.

To determine a winner, take the number of "gidgets" a firm can produce (plant capacity) times $20 and add cash-on-hand. The team with the most capital wins.

B. Student Activities:

1. Student market simulation material should be distributed to the class one day prior to organizing the teams. This information sheet is contained in part VI.

2. Answer questions about the handout and divide the class into six teams, each of which will serve as a board of directors. It is recommended that teams be selected on a random basis so a method of communication will have to be developed in each team.

3. Allow ample time for students to reach a decision on; 1) the price to charge for a "gidget", 2) the number of "gidgets" to be produced, and 3) the amount to invest in the maintenance of the plant. These results should be turned into the teacher by a chairman of the board on a student record sheet. This sheet is also in part VI. Every member should be required to keep a record sheet.

4. Feedback results should be obtained and the print out returned to the chairman of the board for his firm only. Allow a few minutes so each team member can record the information.

5. In about a week, allow the board of directors to meet again and make another decision. The game can run as long as the teachers decide, but the teams should be notified well in advance as to when the game ends.

6. The winer will be decided on the basis of $20 for each "gidget" it is possible to produce plus the cash-on-hand.

V. Student Assessment:

The winner will be decided as described before. This should only be part of the consideration on student performance. The following is a list of other considerations which should be taken into account.

A. Group dynamics - the organization, communications, operations, and procedures of the board of directors.

B. The ability of the team to use a decision-making system as described in The Man Made World.

C. Modeling techniques.

D. Effective use of feedback to improve company performance.

NOTE: Questions about the program and descriptive material should be directed to Mr. Larry Bradsby. (address in Preface)

VI. Instructional Materials:

A. Student Description of Marketing Simulation

The setting for this marketing game is a simplified representation of the market for "gidgets" and the industry which produces and markets these products. The game is a simulation of the actual market and manufacturing industry. Some unrealistic restrictions are necessary in order to simplify the situation so that it can be represented by a manageable computational structure. Even with the situation highly simplified, many helpful parallels can be drawn between one's actual experience in the real world and the artificial environment. The "gidget" can be treated as a newly developed product that has just been recently introduced to the public.

Production is considered primarily from the point of view of scheduling in order to illustrate the importance of accurate sales forecasting in maintaining the required level of production while holding production costs in check. Faulty forecasting can result in overtime charges and finished goods inventory or surplus charges. Each firm begins the game with adequate working capital ($5,000), and should not be faced with any financial crises. However, the maintenance of adequate financial records is an important element of the game.

The company your team will manage is one of the six firms in the industry. The industry in the past has been a perfectly collusive oligopoly in which the firms have agreed to share the

market equally. They have worked together to keep out competitors and make the best of a good thing. However, an important development is taking place which will prevent the continuation of this cozy arrangement. The Antitrust Division of the Attorney General's office has been investigating the industry for evidence of price fixing and other collusive agreements. If the new managements of the firms are to avoid prosecution, they must not give the slightest indication of collusive action.

Last month, December, was headed by the old management. Information for that month is as follows:

Industry sales:	30,000
Firm sales:	5,000
Price of gidget:	1.00
Cost of production:	.50
Surplus:	0
Plant capacity:	7,000 units per plant
Operating capital (cash-on-hand)	5,000

Starting January all agreements are off, as the six firms compete for the market. The largest determinate of the market is price charged. The market will follow the rules of "supply and demand." Each board of directors is responsible for making the following decisions each month:

1) Price of gidget.
2) Amount to produce.
3) Amount to invest in maintenance of plant.

The following feedback will be given after each decision to the chairman of the board.

1) Number of gidgets sold.
2) Surplus
3) Unit cost of production for that month.
4) Profit
5) Plant capacity
6) Possible market
7) Cash-on-hand

At the end of the year, a winner will be decided by the amount of cash and the state of the plant of his firm.

HERE IS AN EXAMPLE OF THE INPUT AND OUTPUT FROM THE COMPUTER\

```
RUN
MARKET

MARKET SIMULATION  ---- ORGANIZE THE TEAMS ACCORDING TO PRICE.
  TEAM 1 HAS LOWEST PRICE TO TEAM 6 WHICH HAS HIGHEST PRICE
INPUT THE FOLLOWING INFORMATION FOR EACH TEAM IN THE ORDER
GIVEN SEPERATE EACH NUMBER WITH A ,
PRICE, AMOUNT PRODUCED, AMOUNT INVESTED IN PLANT, SURPLUS,
PLANT CAPACITY, CASH ON HAND
TEAM 1     ?.79,7000,5000,0,7050,5340
TEAM 2     ?.84,7500,3000,0,7000,6100
TEAM 3     ?.87,6000,1000,1896,7000,5917.60
TEAM 4     ?.95,7000,35000-,167,7000,6299.80
TEAM 5     ?.96,6987,650,96,6987,6527.60
TEAM 6     ?1.00,100,100,2084,6955,5941.20
TOTAL MARKET
?40000
COST OF PRODUCTION PER UNIT
?.51

TEAM 1
NUM SOLD   SURPLUS   UNIT COST   PROFIT   PLANT CAP   POS MKT   CASH
 7000        0         .51        1960      7250       10000     2300

TEAM 2
NUM SOLD   SURPLUS   UNIT COST   PROFIT   PLANT CAP   POS MKT   CASH
 7500        0         .51        2233.75    7100      8333     5333.75

TEAM 3
NUM SOLD   SURPLUS   UNIT COST   PROFIT   PLANT CAP   POS MKT   CASH
 6666        1230        .51        2153.76    7000      6666
 7071.36

TEAM 4
NUM SOLD   SURPLUS   UNIT COST   PROFIT   PLANT CAP   POS MKT   CASH
 6666        501       .51        2832.84    7125      6666     5632.64

TEAM 5
NUM SOLD   SURPLUS   UNIT COST   PROFIT   PLANT CAP   POS MKT   CASH
 5000        2083        .51        1833.4     6969      5000        7711

TEAM 6
NUM SOLD   SURPLUS   UNIT COST   PROFIT   PLANT CAP   POS MKT   CASH
 2184        0         .51        1070.16    6910      3333     6911.36

DONE                                101
```

RUN
MARKET

```
10  PRINT "MARKET SIMULATION  ---- ORGANIZE THE TEAMS ACCORDING ";
20  PRINT "TO PRICE."
30  PRINT " TEAM 1 HAS LOWEST PRICE TO TEAM 6 WHICH HAS HIGHEST PRICE"
40  PRINT "INPUT THE FOLLOWING INFORMATION FOR EACH TEAM IN THE ORDER";
50  PRINT "GIVEN SEPERATE EACH NUMBER WITH A ,"
60  PRINT "PRICE, AMOUNT PRODUCED,AMOUNT INVESTED IN PLANT, SURPLUS,";
70  PRINT "PLANT CAPACITY,CASH ON HAND"
80  FOR I=1 TO 6
90  PRINT "TEAM";I;
100  INPUT P[I],R[I],A[I],S[I],L[I],N[I]
110  NEXT I
120  PRINT "TOTAL MARKET"
130  INPUT T
140  LET P[7]=P[8]=P[9]=P[10]=0
150  LET M[1]=INT(T*.25)
160  LET M[2]=INT(T*5/24)
170  LET M[3]=INT(T/6)
180  LET M[4]=INT(T/6)
190  LET M[5]=INT(T*.125)
200  LET M[6]=INT(T/12)
210  FOR I=1 TO 6
220  IF P[I]=P[I+1] THEN 250
230  NEXT I
240  GOTO 360
250  IF P[I+1]=P[I+2] THEN 290
260  LET M[I]=(M[I]+M[I+1])/2
270  LET M[I+1]=M[I]
280  GOTO 230
290  IF P[I+2]=P[I+3] THEN 330
300  LET M[I]=(M[I]+M[I+1]+M[I+2])/3
310  LET M[I+1]=M[I+2]=M[I]
320  GOTO 230
330  LET M[I]=(M[I]+M[I+1]+M[I+2]+M[I+3])/4
340  LET M[I+1]=M[I+2]=M[I+3]=M[I]
350  GOTO 230
360  FOR I=1 TO 6
370  IF P[I]>1.1 THEN 390
380  GOTO 430
390  LET M[I]=M[I]*.9
400  IF P[I]>1.2 THEN 420
410  GOTO 430
420  LET M[I]=M[I]*.7
430  NEXT I
440  FOR I=1 TO 6
450  LET Q[I]=R[I]+S[I]
460  NEXT I
470  FOR J=1 TO 6
480  LET U[J]=Q[J] MIN M[J]
490  LET S[J]=Q[J]-U[J]
500  LET I[J]=U[J]*P[J]
510  NEXT J
520  PRINT "COST OF PRODUCTION PER UNIT"
530  INPUT K
540  FOR J=1 TO 6
550  LET C[J]=K*R[I]
560  F[J]=I[J]-C[J]-.2*S[J]
570  NEXT J
580  FOR J=1 TO 6
590  IF L[J]<U[J] THEN 610
600  GOTO 620
610  LET F[J]=I[J]-C[J]-.05*C[J]-.1*(U[J]-L[J])
620  NEXT J
630  FOR J=1 TO 6
640  LET B[J]=(L[J]-50)+A[J]/20
650  LET N[J]=N[J]+F[J]-A[J]
660  PRINT "TEAM";J
670  PRINT "NUM SOLD  ";"SURPLUS  ";"UNIT COST    ";
680  PRINT "PROFIT    ";"PLANT CAP    ";"POS MKT  ";"CASH  "
690  PRINT U[J];" ";S[J];" "K;" ";F[J];"";B[J];"";M[J];" ";N[J]
700  PRINT
710  PRINT
720  NEXT J
```

STUDENT RECORD SHEET

price	ending produced	invested plant	number sold	surplus	unit cost	profit	plant capacity	possible market	cash	

I. Title of Unit:

JUST ONE MORE TIME - A STUDY
IN RE-CYCLING RESOURCES

II. Instructional Objectives:

A. Students discover magnitude of waste disposal problem by investigation of single category of potentially re-usable waste(throw-away bottles and cans).
B. Students survey attitudes of producer, distributor, retailer and user toward throw-away containers.
C. Students produce a model of present "use-discard" system and a model of a closed system that would salvage and reuse basic resources.
D. Students reach decision on course of action to follow: i.e., quit, try to inform community with view toward producing an action program, or undertake an action program designed to change real situation to conform to proposed re-cycling model.
E. Students assess long-range results of decision reached in (D).
F. Students involve people outside of immediate class in their activities.

III. Rationale of Unit:

Use of waste and reuse of natural resources is rapidly becoming a major issue in our increasingly urban and technologically-oriented society. This activity unit provides immediate application of decision-making and modeling techniques to a real-world situation.

IV. Instructional Procedures:

A. Introduce students to Vance Packard, THE WASTE MAKERS, especially chapter five, "Progress Through the Throwaway Spirit."
B. Form small groups to brainstorm implications, each group to present to whole class what they decided were major effects of throw-away practices on such things as resources, economy, and life styles.
C. Pick one area for indepth investigation, i.e., throw-away versus returnable bottles. Organize groups for collection of all possible data from various viewpoints; i.e., 1) manufacturer, 2) distributor, 3) retailer, 4) consumer and 5) conservationist.

D. Have small groups present findings to class.
E. Have each group prepare 2 models as indicated under objective (C) and present to class.
F. Have students make a decision (objective D). It is possible that several decisions may be reached and that small groups may wish to initiate several lines of action.
G. Implement decision reached in F. (Such implementation, if a course of positive action is decided upon, will require another complete student activity).

V. Student Assessment

Methods of assessment will depend in part upon what course of action, if any, students decide upon. Should they decide to try to eliminate use of throw-away bottles in their community, assessment of success would be easy. In any event, each student should make a brief written evaluation of what he accomplished toward realizing the group's objectives.
The multi-disciplinary team will need to make subjective determination of accomplishment by groups in the light of both general course objectives and specific activity objectives.

VI. Instructional materials and equipment:

A. Requirements for special materials are minimal and pose no special problems.

B. The Only Way Out of Pollution, American Legion Magazine, Je, 70.

C. Vance Packard, The Waste Makers.

I. Title of Unit

TECHNOLOGY AND VALUE SYSTEMS

II. Instructional Objectives:

A. To provide students with the opportunity to examine their own value constructs.

B. To provide students with the opportunity to examine their value systems relating to the local community.

C. To identify the effects of technology upon those value systems.

D. To devise feedback mechanisms which will help to achieve goals.

E. To examine methods of attacking value-oriented problems.

F. To motivate various student initiated activities and projects.

III. Rationale of Unit

As students begin to examine the dynamics of the interrelationships of society and technology, it becomes quite apparent to them that values and value systems very often hamper efforts to produce the change necessary to solve evolving social-technological problems. Some of the more obvious examples would be: "the pill," as a solution to population control; laws which would reduce the use of the automobile, as a partial solution to air pollution; and technological innovations in education, which seek to provide flexibility and individualization in teaching.

As a result, the following activity has been developed to provide students with an opportunity to investigate technologically-oriented social systems affected by related value constructs.

IV. Procedure:

A. Have students bring pictures which reflect some value of society. (No more than three each from a different source: i.e. magazines, newspapers, etc.) Students should be told to bring at least one picture which reflects what they consider to be a positive value and one negative.

B. Produce a representative set of slides from their pictures. This requires rather delicate selectivity. With a class of 25, the team must reduce 75 pictures to a more manageable 20 or 25. Theoretically, one from each set of three would accomplish this.

However, diversity is most desirable and should not be sacrificed. Once the selections have been made by the team, students may be used to actually produce the slides.

C. Project the slides as a set, one each at four second intervals, and require students to write on paper a Positive (+), Negative (-), or indifferent (O) response to each slide. It should be clearly understood by the students that these responses indicate a judgment concerning the social value reflected by the slide and not a judgment concerning the aesthetics reflected by the slide. (Appropriate background music is suggested, i.e., "Master Jack.")

D. Collect sheets and record data for each slide on a composite. Do not expose the results at this time.

E. At this point a brainstorming activity of value-oriented terminology is most important. Before they may verbalize the above "positive-negative" level of response, they must be equiped with meaningful terminology. After brainstorming as many words and expressions as possible, it would be necessary to go through the list and clarify those that need clarification and eliminate those that are too vague or ambiguous. (Ex. good, bad, acceptable, disgusting, like, deplorable, "ratty," "close.")

F. Then reshow slides, allowing more time, and have them identify E each slide in the value-oriented terminology, determined in step .

G. Collect sheets and make a "key word" composite.

H. Return both sheets so that students can compare their "positive-negative" responses with their verbal responses.

I. Divide students into groups (not larger than 4 or 5), and have them identify which values have been affected by technological changes and which values, if any, act as "stumbling blocks" to social and technological changes necessary for the resolution of those problems which were introduced by the slides and discussion. (population, and problem areas related to population should naturally evolve.)

J. The question of power structures within a community and how to cope with them is a common reaction of students. It is suggested that those students who are interested in this aspect of the problem be introduced to the game "Star-Power," (see chapter 7 of this guide for description and source) for the purpose of demonstrating the difficulty of effecting change because of existing power structures and relative value constructs.

K. Ultimately, the "Technology and Value Systems" activity should lead into a divergence of student initiated projects related to technologically-oriented problems. It is essential that students

be exposed to the effects of a static value system in a dynamic society. At the same time, it is important that the teacher not impose his value system upon the students.

V. Student Assessment:

Of the six objectives listed, only C, D, and F lend themselves to evaluation techniques which can reasonably be translated into quantitative or literal grades. Even then a high degree of subjectivity relating to quality and effort is required. It is therefore recommended that evaluation include individual student and group assessment of the outcomes, as well as teacher assessment (see Chapter 2).

Objectives A, B, and E tend to be "activity" oriented. That is, the design of the activity has a great deal to do with the successful accomplishments of those objectives and, therefore, they should be evaluated by the student.

VI. Description of Materials

A. Pictures (supplied by students)

B. Means of converting pictures to slides (preferrably, but not necessarily, done by students)

C. Slide projector

D. Tape recorder

E. "Star Power" (see chapter 7)

F. Analog computers (for introduction to dynamic population models)

G. Time-sharing computer, if available, but not necessary. Excellent opportunity for students who are interested in computer program modeling.

I. Title of Unit:

HOW MANY CHILDREN SHOULD I HAVE?

II. Instructional Objectives:

A. Student discovers scope of world population growth.

B. Student identifies school, parent, and community attitudes toward world population growth.

C. The student constructs a statistical model of attitudes.

D. The student orders statistical data in terms of his knowledge of population growth.

E. The student describes results to group.

F. The student interprets findings with reference to his own adult life.

G. The student discovers a closer relationship between classroom activities and decisions that will be required of him.

III. Rationale of Unit:

This unit is in the course because population is one of the major concerns facing man today. It may be capable of solution with the aid of technology, although technology has done much to aggravate the problem in recent years.

IV. Instructional Procedure:

A. Students might read Kenneth Boulding's Meaning of the 20th Century, or explore other source materials. Open-ended class discussions or small group discussions will help delineate the problem and suggest means for implementing (B) below.

B. Form groups to survey the following to discover attitudes on population and to elicit any proposed solutions.
1. other students
2. parents
3. community (religious and civic leaders)
4. welfare and minority groups

See attached sample of questionnaire, and information sheets, as an example of a student-developed and executed use of this activity.

C. The students develop a statistical model to portray results of questionnaire.

D. The students assess model in light of their prior knowledge of population dynamics and describe results of study to class.

E. Spin-offs might include discussions involving interested students from school community, talks by resource people, more intensive studies into local population control measures, and the relation of population explosion and poverty.

V. Student-Teacher Assessment of Unit

A. Teacher assesses (subjectively) class reaction to IV (D).

B. Group performing activity writes a brief self-evaluation on:
1. How well were Instructional Objectives achieved?
2. Were any additional worthwhile results achieved?
3. How could activity be improved?
4. How close to real life is the model developed in IV (C)?

VI. Description of Instructional Materials and Equipment:

A. Kenneth Boulding, The Meaning of the 20th Century

B. Student-devised questionnaire

The Population Problem Part I

A Survey Conducted Under the Auspices of The Man Made World

By Leonard Slosky

June 1984

After centuries of futile effort, man finally developed the skills necessary to reduce infant mortality and increase the average life span. Such techniques were first developed in Western Europe and subsequently spread throughout the entire world. Unfortunately there has not been a corresponding decrease in fertility. In the 1950's and '60's the people convinced themselves that food was the solution. Recently it has been acknowledged that the population of the earth must be controlled if the human species is to survive. Many people had warned of the coming famines and overpopulation for the last two hundred years but their warnings were never heeded. Few realized that the time would actually come when they would have this problem to cope with themselves.

The age of famines began in 1974 when one million people died in one day from the lack of food. Since this time the death of over one million people a day has not been uncommon. In fact before the Great Chinese-Russian Land War began it was estimated that up to one million people died per day in China. Due to the wide and nauseating coverage provided by the mass media no further details are necessary.

The Population Problem Part II

A. Survey Conducted Under the Auspices of The Man Made World

By Leonard Slosky

OPINION SURVEY

Please Circle

Male Female

Soph. Jr. Sr.

Please Answer (using back side if necessary)

1. How many children do you want to have?

2. By what year do you think the world's population will be twice what it is today?

3. Is food production keeping pace with population growth?

4. Should we give massive aid to nations like India?

5. Do you think something will prevent mass starvation? if so, what?

6. How soon do you think mass starvation will begin?

7. Providing the U.S. can produce enough food, should our population be limited?

8. Do you feel population control is a function of government?

9. Who except government can control population?

PLEASE GIVE ANY OPINIONS OR COMMENTS REGARDING POPULATION.

Presidential Decree #127-76-250 June 4, 1984

Effective this date: every female upon reaching ten years of age must report to the National Fertility Control Board within ten days. At this time each female will be issued a Birth Apportionment Card which endows the holder to cultivate 2.2 offspring to maturity. Failure to report to the National Fertility Control Board may result in life imprisonment. Failure to comply with the Birth Apportionment Regulations may result in death to the progeny.

BIRTH APPORTIONMENT CARD

The holder of this card is endowed with the privilege of cultivating 2.2 offspring to maturity.

0	0	0
1	2	2.2

Punch out upon delivery

0	0	0
1	2	2.2

Punch out upon maturity

DO NOT BEND, STAPLE OR MUTILATE

NOTE: NONFLAMABLE

ATTENTION: DETACH AND RETAIN

The Population Problem

The situation presented in the Population Problem Part I is not a fantasy but in fact what may exist in a few years. In general, it is now probably too late to prevent mass starvation. Our foreign policy and every international act must be evaluated in light of over population and famine. A recent President once said that Birth Control is none of this government's business. Yet, the future of our country and even of the human species depends on OUR ability to control population. For the United States it is not too late if WE start NOW. Extreme measures need not be taken now in the United States. However education must be extensive and the encouragements significant in order to preserve the existing quality of life.

> If we now ignore the plight of unborn generations which, because of our unreadiness to take corrective action in controlling population growth will be denied all expectations beyond abject poverty and suffering, then history will rightly condemn US.
>
> - D. D. Eisenhower